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William B Rogers

SCIENCE

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FRIDAY, JULY 2, 1897.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

LIFE AND LETTERS OF WILLIAM BARTON ROGERS.

THE present generation of men and women have shown in an extraordinary degree their interest in the personality of historical characters.

Current literature teems with examples of this interest in biographical sketches without number, and the public seems to enjoy the most trifling details of the lives of persons of distinction, to secure which both the pen and the camera are driven to the last limit.

That this taste has abnormally developed and is in a large measure harmful few will deny, but there will always exist a wholesome curiosity as to the personal qualities of men whose performances have commanded our admiration. It is not alone in political history that biography is so important. To the student of science a knowledge of the temper, spirit, moods or idiosyncrasies of eminent scientific men has always been highly valued, not only on account of its intrinsic interest, but also because such knowledge often assists in a proper interpretation and appraisement of their work. But when distinguished success is to be attributed to personal qualities even more than to talent; when to scientific accomplishments of a high order is joined a personality so charming and so noble as to silence opposition and command approval, anything that reveals, even a small

degree, the motives, inspirations or promptings of such human activity is doubly welcome.

The 'Life and Letters' of Professor W. B. Rogers, edited by his wife with the assistance of Professor W. T. Sedgwick, has recently made its appearance.* The memoir is published in two beautifully printed volumes of about 400 pages each. In the short preface to the first the editors explain that they have been prepared in the hope that they 'may be of some service to the cause of science and education.' Their work has been done with rare wisdom and good taste. It has consisted mainly in providing a continuous yet unobtrusive background of biography, upon which is displayed an extensive and wonderfully interesting series of letters, in which the whole story of the life of Professor Rogers is revealed.

It may be well in the beginning to briefly summarize in their chronological order the principal events of that life. Professor Rogers was born in Philadelphia in 1804. His father was Dr. Patrick Kerr Rogers, who was himself born in Ireland in 1776, the son of Robert Rogers, of Edergole. Mr. P. K. Rogers fled from Ireland on account of articles which he had contributed to the Dublin newspapers in criticism of the action of the government in the matter of the Irish Rebellion of 1798. Coming to Philadelphia he entered the University of Pennsylvania as a tutor, and in 1802 he received the degree of Doctor of Medicine from that institution. A year before graduation from the medical school he married Hannah Blythe, who had come from Glasgow to make her home in America. She died in 1820, leaving four sons, James B., William B., Henry D. and Robert E. Rogers, all of whom became eminent in science and in public life, being frequently spoken of in Europe and in this country as 'the brothers Rogers.'

Dr. P. K. Rogers removed with his family to Baltimore in 1812, and in 1819 he was elected to the chair of natural philosophy, which at that time covered a very broad field, in William and Mary College, Virginia. William was a student here in 1819–20, and there is printed in the memoir an interesting fac simile of a report of the standing of the two sons, James and William, in which, in addition to the statement that they had been 'orderly, diligent and attentive to their studies,' there is an interesting forecast of their career in the declaration that 'in mathematics and chemistry they have made the most flattering improvement.' There is good evidence, some of which is found in the fragments, which have been preserved, of a correspondence with Thomas Jefferson, that Dr. Patrick Rogers was an accomplished mathematician and general scholar and that the tastes and talents of the 'brothers Rogers' were largely inherited. When James, at the early age of 19 years, was studying medicine in Baltimore he wrote to William, aged 17 years, a letter full of criticism of the 'singular views' advanced by one of his professors on the subject of chemical attraction or affinity and the true cause of chemical union. He begs William to give him his own opinion of the matter in an early reply, and concludes with a burst of filial loyalty in the declaration that, although the aforesaid professor is the best lecturer in the institution, the lectures of their father on the same subject as far surpass his work 'in point of correctness, science and elegance as the meridian sun does the evening star in brilliancy.' In a youthful oration given by William on a public occasion in 1822 he foreshadowed, at the age of 18, the eloquence of speech for which he was in later years famous.

* Published by Houghton, Mifflin & Co., Boston, to whom we are indebted for the plate of the portrait accompanying this article.

In 1825 both William and Henry removed to Baltimore to seek their fortunes, but the physical weakness by which they were greatly handicapped and against which they fought during all of their lives interferred with their success from the start. The two brothers finally obtained employment as teachers, but there was frequent necessity for pecuniary aid from the father, who was ever ready to draw upon his slender salary the payments of which were made with much irregularity and often much delay, for the benefit of his sons, of whom he was extremely fond and justly proud.

William began to show his rare qualities as a lecturer on Science, and in 1827 he was appointed to a lectureship in the Maryland Institute. His father died in 1828 and in the same year he was elected as his successor in the chair of natural philosophy at William and Mary, at the early age of 24 years. Here he remained for seven years, growing in knowledge and reputation, and in 1835 he was elected professor of natural philosophy in the University of Virginia, and shortly afterward he was appointed State Geologist. His connection with this institution continued for eighteen years, and its history forms one of the most interesting features of the memoir. During this period the University passed through some of its most notable trials in connection with the relations of its governing authority, the faculty, to the student body. In all of these events, as well as others of more lasting importance to the institution, Professor Rogers was a prominent figure. That he impressed himself in a notable way upon the then young and developing University was always recognized by its officers and friends. That his connection with it, and especially his long life in the South, covering as it did his youth and the most impressionable years of his manhood, did much to influence his educational ideas as well as his personality, is equally true. Indeed, there was always in his manner something of that courtliness and chivalry which we are wont to associate with the cultivated Southern gentleman and when transplanted to New England it became one of his principal charms. During his life in Virginia his fame as a lecturer and scientific investigator grew continually. He was invited to lecture in various cities, and just previous to his leaving the South Professor Henry solicited his assistance in a course to be given 'for the benefit of Congress' at the Smithsonian Institution.

In 1849 he married Miss Emma Savage, of Boston, going with her to Europe, where some pleasant months were spent and valuable acquaintances formed or renewed, and returning to the University of Virginia in October of the same year. In 1853 he resigned his professorship and removed to Boston, where his wife had lived and where her family and friends were, and also where his brother Henry had already met with such generous support and assistance in his scientific work. Here, for a period of nearly ten years, he worked, wrote and lectured, all the time keeping in mind the organization and development of a school of technology or applied science, the plans for which had been in his mind since at least as early as 1846. On April 10, 1861, the Act incorporating the Massachusetts Institute of Technology received the approval of Governor Andrew, just as the Nation was plunging into what proved to be a mighty struggle for its existence. A year later he was formally elected President of the Institute, which as yet had no material existence. Indeed the war for the preservation of the Union delayed the consummation of his desires until October, 1865, at which time instruction in the new school was actually begun.

In 1868 Professor Rogers began to show the effects of the years of devoted activity which had resulted so fortunately as far as

the school was concerned, his always rather delicate health giving way to such an extent as to make a prolonged period of rest imperative. Accordingly he resigned his presidency of the Institute in 1870, and lightened his labors as much as was possible. In 1876 he presided over the meeting of the American Association for the Advancement of Science in Buffalo, a meeting which was distinguished by the attendance of many foreign savants who were drawn to this country by the Centennial Exposition, held that year in Philadelphia. He had been specially chosen by his fellows to preside on that occasion, because of their desire to put forward the best available representation of American science.

In 1878, on the resignation of Professor Runkle, who had succeeded him as President of the Institute of Technology, he was induced to accept that office again, with the understanding that his holding should be but temporary. In 1879 he was elected by the National Academy of Sciences to succeed Professor Henry as its President, the highest honor which can be conferred upon a man of science in this country. In 1881 he again resigned his presidency of the Institute of Technology, General Francis A. Walker having been selected by him and appointed on his recommendation as his successor. A year later, at noon of May 30, 1882, came his tragic death. In the midst of an address to the graduating class of the Institute, in which his hearers were delighted with an apparent revival of the spirit and eloquence with which he was accustomed to enrich every occasion for dignified address, he fell upon the platform of Huntington Hall, surrounded by the material realization of his dreams of nearly forty years earlier and by those who by the closest associations had learned to love him as few are loved in these days.

Fit into this skeleton sketch the interesting letters which happily have been preserved, mostly being correspondence with his brothers or family friends, and the story of his long and useful life will be fairly well told, although to form an adequate idea of his accomplishments in science and education one must consult the appendices to the two volumes where will be found a list of his scientific publications and one or two of his more important educational papers. I may venture, however, to give the reader of this notice a little taste of what the volumes have in store for him, and at the same time illustrate the remarkable biographical value of the published letters by quoting from a few of them.

Mention has been made of his power as a lecturer on scientific subjects and of his ability to stir with eloquence even when comparatively dry and interesting material was under discussion. One of his early pupils at the University of Virginia says of him that he was endowed with "not alone an imagination which ever clothed truth with beauty and made the dullest fact radiant with a significance illimitable and imperishable, but also every personal gift which can enhance the power of the orator. Tall in stature, with a figure of the type known to us through the pictures of Henry Clay; with a face that, destitute of all assumption or arrogance, was singularly commanding; with a voice whose compass and quality were capable of producing at once the largest and the finest effects of speech, William Barton Rogers was, in the height of his powers, without a peer among the scientific men of his age in addressing an intelligent and cultivated audience." This remarkable *faculty for teaching* was appreciated by all who came in contact with him. Theodore Parker wrote to him in 1859, when just on the point of starting for London: * * * * * * "I return Mr. Owen's remarkable pamphlet. What an instructive thing it is!

"I should have been surprised that it could all have come from one man if I had not known yourself and your brother, who in such matters taught me the *nil admirari.* * * * Allow me to thank you for the instruction I have received from you, and for the many friendly and noble words you have spoken to me. My acquaintance with you began with your brother, and I feel gratitude to you both. For you both turn your deep, wide science into humanity. I have found you both always on the side of mankind and feel strengthened and encouraged by your example." Wherever and whenever good speaking was understood and appreciated Professor Rogers was in demand. When in England, in 1849, he attended the annual meeting of the British Association for the Advancement of Science, and in the presentation of a scientific paper his extraordinary power of exposition was at once recognized. He was put down for a speech at the great dinner which celebrated the close of the session, and in a letter written on the morning of the day on which it occurred he wrote: "I suppose I shall be compelled to show my Yankee 'gift of the gab.'" He met with a flattering reception at the hands of such men as Darwin, Faraday, Murchison, Sedgwick, Brewster, Mallet and Adams. He writes to his brother: "You may imagine how my heart beat to hear your name so honored and to have our labors so warmly eulogized."

The younger Mallett, who was present on the occasion, afterwards said of it: "Although I was but a boy at the time, attending the meeting with my father, I recollect most distinctly the marked impression made on the large assembly by Professor Rogers's speech and the enthusiasm it kindled. It came late in the evening, after much, perhaps most, of the matters appropriate to the occasion had been utilized by others, yet it was clearly *the* success of the banquet. Americans were less known in England than they have since become, and the slight foreign flavor which accompanied a speech, excellent in itself, and fluently delivered in the mother tongue, added to the piquancy and effect." The orator, like the poet, is hardly a manufactured product, but all who have occasion to lecture on scientific subjects will be greatly interested in and benefited by the many hints as to his own ideas of how difficult subjects may be clearly set forth, which will be found in Professor Rogers's earlier letters to his brothers.

In a letter to his brothers, James and Robert, written from Virginia in 1841, he writes as follows: "Do not attempt to crowd too much into a single lecture, and avoid the common error of experimenting for the eye and not for the understanding. Every experiment ought to be accompanied by a full and clear explanation, and this cannot be too explicit and elementary. Cultivate a deliberate and distinct enunciation without sacrificing earnestness and animation of manner. Above all, do not attempt to be over choice in your phraseology, but use the language suggested at the moment. * * * * In my view, the very first thing to be sought is a feeling of ease and confidence, and this, when the subject is thoroughly understood, you cannot fail to secure at the outset by giving play to some enthusiasm, and, as Rutledge advised, 'speaking right on,' even though at times your phrase may be obscure, inelegant or even incorrect."

The whole of his extensive correspondence with his brothers is filled with evidences of the intense affection and brotherly love which existed among them. They understood and appreciated one another. In 1822 James, aged 20 years, wrote to William, two years his junior: "I have, I think, perceived in Henry (aged 14 years) that constitution of mind which is admirably fitted for success in this world and which, if properly cultivated, would mani-

fest genius of no ordinary cast." Some years later William wrote: "* * * But by and by, my dear Henry, we shall, I trust, be able, shoulder to shoulder, to win a position in which we may enjoy ourselves in science and society, free from all anxiety and in a spirit of entire independence." Again on a Christmas day several years later: "My heart longs more than I can express for the coming time when we may all spend together, as in childhood, these festival days, and when we shall always be so near as not to feel the sense of separation."

Both Henry and William struggled against many difficulties, the former in Pennsylvania and the latter in Virginia, to secure the legislation necessary to the execution of a geological survey, and their experiences, as recounted in their correspondence, may serve to encourage those who are struggling towards similar results in more modern days. In 1841 Henry sent to William the complete verbatim report of the speech of one Senator at Harrisburg, one who in private conference had promised his support, which was as follows: "Mr. Speaker, I shall vote against this appropriation, on the ground of its unfairness to other sciences of like nature to this geology. The bill, sir, makes no provision for phrenology, physiognomy, animal magnetism and the highly important science of *water-smelling;* it is partial and I shall vote against it." Both William and Henry had rare gifts of argumentative power and it was exceedingly uncommon for either to fail in carrying with them men whose support was needed. It was his eloquent earnestness and unselfish enthusiasm that brought to Professor Rogers the greatest success of his life, the establishment of the Massachusetts Institute of Technology.

The first plan for the organization of this institution he drew up early in the year 1846, several years before he left the University of Virginia. In a letter to his brother Henry he says: "Ever since I have known something of the knowledge-seeking spirit and the intellectual capabilities of the community in and around Boston, I have felt persuaded that, of all places in the world, it was the one most certain to derive the highest benefits from a polytechnic institution." When in 1860 he thought the time had come for an active prosecution of his scheme he was tireless in his labors, preparing and submitting plans and reports for the Legislature, delivering public addresses on the importance of technical and scientific training, enlisting support from men of wealth and influence, becoming, in fact, himself the embodiment of the whole enterprise. It is unnecessary to say that the story of the last twenty years of his life is, in a large measure, the history of the first twenty years of the Institute.

The frequent references in his correspondence to the intellectual and scientific activity of the time are extremely interesting. To one accustomed to the quieter and more deliberative methods of the South in all matters of a literary or scholarly sort the intensity of life in Boston was something of a revelation. Henry Rogers was the first to taste of this and he wrote to his brother William as follows:

"For a man of any brains whatever, Boston has no peace or quiet; all is restless excitement and unproductive change of thought and of pursuit. The overworking of the brain here without the fruits of intellectual labor is appalling to a mind of contemplative tendencies. Often do I envy you and Robert your calmer studious atmosphere."

The active dissipation of mental energy thus portrayed may not be entirely absent from the intellectual life of the 'Huf' even to-day, but Professor Rogers was not frightened by its existence forty years ago and he speedily adapted himself

to his changed environment. Although he shortly became a prominent figure in social as well as scholarly circles he still retained his fondness for real, hard scientific work, and during his busiest life in Boston made many scientific investigations of great interest and importance.

His personal acquaintance with eminent men of science on both sides of the Atlantic was extensive and his occasional references to them in his letters add greatly to their value. It was in the earlier years of his connection with the University of Virginia that Professor Sylvester came from England to succeed Bonnycastle as professor of mathematics. Professor Rogers had for some time after the death of the latter carried on the work of the department and he was naturally much interested in the arrival of his relief. He wrote: "For several days we have been anxiously looking for the arrival of Professor Sylvester; we learn he lost all his baggage in Boston; this may have detained him"—which goes to show that some of the personal peculiarities of the distinguished mathematician were not confined in their exhibition to later periods of his life. Again, a few weeks later: "The faculty, students and others attached to the University are all greatly pleased with Mr. Sylvester. He was terribly embarrassed at his first lecture, indeed quite overwhelmed, but has been doing better since. He has a good deal of hesitation, is not fluent, but is very enthusiastic and commands the attention and interest of his class." His brother, Robert E. Rogers, who had for some time filled the chair of chemistry in the University of Virginia, was appointed in 1852 to the professorship of chemistry in the University of Pennsylvania, made vacant by the death of his brother James. He was succeeded in Virginia by Professor J. Lawrence Smith, of Kentucky, already a chemist of distinction. He brought with him two young men as assistants, George J. Brush and Ogden N. Rood, both of whom were to achieve distinction in later years. Of the first Professor Rogers wrote in 1852: "Young Brush is a zealous mineralogist of the Yale School, and seems to be familiar with all parts of chemical analysis. He talks a great deal and very admirably of young Silliman and Dana, and I find that he supposes New Haven to be the great center of American science." In 1853, after having resigned his professorship in the University of Virginia, he wrote concerning the well-known professor of physics in that institution: "My successor is young Mr. Smith, the mathematical tutor, and a favorite pupil of mine."

In 1857 Henry D. Rogers was appointed to a professorship in the University of Glasgow, Scotland, and the correspondence of the brothers became more interesting on account of the wider range of personal acquaintance and association which naturally resulted. In 1859 William wrote to Henry: "I read William Thomson's speech with great interest, and should be glad to see him operate with his ingenious instruments. It is rare to see such profound mathematical knowledge united to such skill in its application to physical questions, and such ingenuity in mechanical contrivance." It would be difficult to find a better description of Lord Kelvin than this. Henry had lectured at the Royal Institution, and on March 11, 1856, William wrote: "Tell me in your next what sort of an audience you had at the Royal Institution. What is Faraday about just now? and Wheatstone? Tyndall seems to be taking a leading part at the Royal Institution. He has fine talents and I hope he is a good fellow; but where is there another Faraday?"

An interesting letter dated August 1, 1860, from James Russell Lowell, who was then editor of the *Atlantic Monthly*, reveals the fact that Professor Rogers had sent him

a list of remarkable blunders in an article on meteorology which that magazine had published. The criticism is accepted in a most good-natured fashion, and Mr. Lowell explains how he proposes to make acknowledgment of the mistakes in the *Monthly*. It is to be done by a humorous editorial, in which the blame for accepting the unfortunate article is to be thrown upon the 'Æsthetic Editor,' who ran the establishment all alone, during the absence of the 'man of science;' and all this, Mr. Lowell says, because "no right-minded magazine can allow itself to be corrected *ab extra*." One might almost conclude that modern journalism had learned some of its lessons from this venerable and always proper and respectable periodical.

A note from Charles Sumner, written at Washington in 1863, reveals something of the anxiety by which men's minds were filled in those days. It concludes: "I wish I could talk with your brother for half a day. Remember me to him most kindly. I know he keeps his loyalty. But what does he say of England—our England—and her shortcomings?"

Indeed there is nothing in these volumes more impressive or more worthy of the distinguished man whose life they unfold than the continued utterances of patriotism and loyalty in which his letters during the war period abound. In giving full weight to this statement it must be remembered that the greater part of Professor Rogers's life was spent in the South; that he grew to maturity amid Southern influences and that he numbered among his personal friends many who were afterwards prominent in the attempt to overthrow the government.

During the early 'fifties' there are frequent references in his letters to the storm which he distinctly saw was threatening the Republic. His faith in the indestructibility of the Union was lasting and strong. In 1856, writing of the difficulties in Kansas, he said: "I am, however, of those who think that our Union is too strongly framed in Constitutional right, and bolted together by mutual interest, to be severed by even such a shock as this." In 1858 he wrote to Henry: "I see with sorrow and indignation that Senator Mason contemplates some general provision for bringing new States into the Union by *pairs*, so as to maintain the present balance between the slave and free States! But this *cannot be done*." Early in 1861, again to Henry: "The fears of State Street and the prejudices of Beacon Street may have some effect, but the great mass of New England and, I think, of the free States in general, will refuse a compromise which claims national protection to slavery far beyond the extent of the present Constitution." And a few days later: "Should the Gulf States remain out of the Union I see little reason to expect a better fate for them than is seen in the degradation, destruction and fickleness of the South American Republics."

During the years in which the Civil War was waged Professor Rogers was especially active, through his brother Henry, in striving to enlighten the people of Great Britain as to the real situation in this country, and there can be no doubt that the excellent social relations which the two brothers enjoyed with people of rank and influence in London, Edinburgh and Glasgow contributed largely to this end. Immediately after the firing upon Fort Sumter William wrote to Henry at great length, saying, among other things: "It is of great importance that the position of the free States and National government in this contest should be truely known in England. Every word of sympathy, or even of toleration, for the South arising from Europe, and especially from England, is magnified by the excited people there and does great harm. * * * It grieves and mortifies me to see several of my old

friends and pupils among the most passionate leaders in this revolt."

Professor Rogers found many channels in which to suppress his feelings of loyalty and patriotism, and the newspapers of the time record the fact that only a week or two after the outbreak of hostilities when he was called upon to speak at the Thursday Club on some matter pertaining to science he "very gracefully declined to discuss the topic proposed, and then made a stirring appeal to the Club in favor of providing a regiment of our brave volunteers with knapsacks." This appeal was seconded by the Hon. Edward Everett, the President of the Club, and in a few minutes a thousand dollars were subscribed.

Innumerable examples showing this intense spirit might be quoted, not alone from letters to his brother in Glasgow, but from those to many prominent Englishmen whose friendship he enjoyed. During the darker days, in spite of his feeble health, he made patriotic addresses on Boston Common and on September 26, 1862, he referred to the Emancipation Proclamation of President Lincoln in the following thrilling words, a part of a letter to his brother Henry: "The great event since my last letter, the greatest event beyond comparison of the war, is the late proclamation of the President, declaring the slaves of all rebellious States after January next to be *forever free*. On the 22d of September this momentous voice was uttered. On that day—in a sublimer sense than ever before—*the sun crossed the line*."

Under date of July 5, 1863, he describes the celebration of the 'Fourth' in Boston. Dr. Holmes gave the oration in the 'great theatre to an audience packed to the dome,' and the enthusiasm was great, all hearts being absorbed in one feeling of patriotism.

As evidence, however, that his interest in the progress of science was by no means dormant during those potentous days, he adds: "What kept me in the city, however, was my interest in the exhibition of the electric light, which the Council, at the instance of George Hale, encouraged by me, decided to make one feature of the evening celebration, as a substitute for part of the usual fireworks." He describes in interesting detail how Ritchie accomplished a superb success by putting a battery of 250 cells on the top of the State House dome, from which a 'flood of light' was thrown upon over 100,000 pedestrians who thronged the streets.

But surely enough has been quoted and enough said to give some notion of the extreme interest of these volumes, not only to scientific men, but to all intelligent people who admire exalted character and lofty sentiment. America has produced no finer type of man than was exhibited in William Barton Rogers, who showed that it was not impossible for one who was primarily devoted to learning and original research in pure science to be at the same time a lovable companion, an eloquent lecturer and a man of affairs whose influence upon his contemporaries resulted in the creation of new institutions and the remodeling of old. It is even now too early to recognize in full measure the value of his life to the people, to whose best interests he showed a rare fidelity.

T. C. MENDENHALL.

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*THE MERTON RULES.**

THESE are the Code of Nomenclature "at present in force for regulating all work done in the study of Microlepidoptera at Merton," and "the object of these rules is to insure absolute obedience to the Law of Priority." In so far as this Code is pecu-

* Rules for regulating Nomenclature with a view to secure a strict application of the Law of Priority in Entomological work. Compiled by Lord Walsingham an [and] John Hartley Durrant. Longmans, Green & Co.: London, New York and Bombay. 2 Nov., 1896. 8vo, pp. 18.

liarly or exclusively adapted to the exigencies of entomological work it is of course not within the purview of ornithology; but its most avowed object of insisting upon the Law of Priority, its whole tenor, and most of its fifty-one canons, are no more pertinent to one branch of zoology than to any other. Lord Walsingham and his secretary thus submit a set of rules to the consideration of all zoologists, and no apology is needed for examining them with special reference to the A. O. U. Code.

Naturalists are in substantial agreement upon such a large majority of the propositions which bear upon the 'highly-contentious' subject of Nomenclature that we should expect any code drawn up by competent workers to be good in the main. Such is emphatically the case in the present instance. If, therefore, we seem to dwell upon the exceptions we take, to an extent disproportionate with the commendation we give, it will be understood that the latter goes without saying. Probably four-fifths of these rules will receive general unqualified assent; it is mainly regarding the remainder that we have here to do. Most of these may be reasonably questioned, and some of them are likely to be regarded as highly objectionable.

We think that the authors make a strong point in the introduction, but it is made so quietly that its full force may not be recognized at first sight. This is where (p. 4), referring to other codes, the authors say they "are not aware that in any of these rules the actual work and intention of an author has been guarded to the same extent as the names which he has given to his conceptions," and then add: "It has been one of our objects to define a method by which the recognition of antecedent work can be consistently secured, regarding this also as no less a moral obligation capable of being met by the same rules which apply to mere names."

This raises a large question, concerning which we are heartily on the side of the authors. We have too often heard it said that, as we cannot enter into the inner consciousness of another, especially if he have lived in other times and been long dead, we have no concern with his spirit, purpose or intents, but only with his acts, and that consequently we must go by what he actually did, without regard to what we may think he intended to do. We believe this to be bad—unjust and dangerous; Lord Walsingham has the right of it in introducing something of a moral or ethical principle, difficult as such may be of application in all cases. An author's intent or purpose can generally be fairly presumed or inferred from his writings; when such presumption or inference is reasonable it surely should not be disregarded, and the cases must be very few in which no meaning is discoverable.

Example: In founding his genus *Dendragapus* Mr. Elliot intended to separate grouse of the *obscurus* group from those of the *canadensis* type. That was the sole intent, purpose, scope and function of his generic name. What right, then, has any subsequent author to use *Dendragapus* for the sole purpose of uniting *obscurus* with *canadensis?* None; such a travesty of the generic name, such a perversion, or rather reversal, of Mr. Elliot's express purpose, is simply nomenclatural hocus-pocus, and as such it is puerile, unscientific and immoral.

There is another point in Lord Walsingham's introduction we must pause to applaud heartily. Though it be one of those which, as we say above, go without saying, it is particularly well said (p. 5): "The object of all rules should surely be to secure precision, uniformity, and finality: any sacrifice of these objects to considerations of mere convenience can only result in the creation of greater inconvenience at some future date. The inconveniences from which

workers in entomology now suffer would have been entirely avoided had the earlier authors studied and recognized the work of their predecessors, or adopted some such rules as are here set forth, beginning from the time of Linnæus. The earliest sinner in this respect was Fabricius, but Stephens in creating the necessity for Rule 48, has exhibited even greater ingenuity in his aberrations." Here, again, is an obvious ethical principle. We do owe something to posterity, notwithstanding the question which some wit once asked: "What has posterity done for us?" This debt is in the nature of a moral obligation not to consult our own present convenience at the expense of those who are to come after us. And if we may disregard the altruism involved, then self-respect and an enlightened selfishness should alike prompt us to the same end, merely as a matter of looking out for our own good repute.

A part of Lord Walsingham's 'Premiss' will be hailed with acclamation by almost every American zoologist. It is as follows:

"Zoology became an intelligent science when it was recognized that every species should possess a special name and every genus a generic name. This system of nomenclature was first enunciated by Linnæus in the 'Systema Naturæ' (edition X.), 1758; and as we owe the conception of the special and generic name to Linnæus, we are bound to commence our nomenclature from the year 1758, when he published his epoch-marking work."

Shade of Strickland! Requiescat in pace! We do not propose to echo an anthem to this requiem, nor even to argue the point; for we could say nothing that has not been said fully and perfectly well in the A. O. U. Code itself in support of this reasonable proposition—one of self-evident logical necessity; and if what is recorded there does not budge our British friends, nothing will move them from the isolation of their insularity. We know that most of our respected colleagues on the other side of the herring pond still stand on the rock of offense, whence to denounce with objurgation those who do not subscribe to the B. A. Code. Possibly we undertook to split that rock with the butt end of our wedge; probably Lord Walsingham may prove to have insinuated the thin edge from his own coign of vantage. He may not be the first among English naturalists to favor the heresy of 'Linnæus at '58;' but he is certainly one of the strongest, and much may be confidently anticipated from the force of his example. We remember once discussing with him in person the 'American idea' of Trinomials. We may have been persuasive, though we failed to be conclusive, in our presentation of that case to his liberal and progressive judgment; but the stand he has now taken against the extreme conservatism of his countrymen leads us to the confident hope of his enlightenment even upon those 'dark sayings' of Trinomialism. If the scales could fall from the eyes of such a one as Saul of Tarsus, a Paul of London, Cambridge or Merton may not be a zoological impossibility in the course of natural evolution.

Passing by most of the Merton rules as self-evident, or as admitted by the concensus of naturalists, or else as peculiar to microlepidopterists*, we note some few

* A valued entomological friend of high standing, who has not authorized the use of his name in this connection, writes to us regarding some of these: "I think that most entomologists would take exception to the group of rules beginning with No. 19 and ending with No. 25, except that No. 23, since it begins with the words 'it is advisable,' is acceptable. Similarly, under No. 33, *e. g.*, Zeller's correction is not admissible. Under No. 38, the third paragraph, indicating that the type is the sum of the co-types. Mr. Oldfield Thomas's terms under No. 39 have not come into general use, though they are sensible enough. Under No. 41: No one accepts the idea that the type of the genus is the sum of the species as under 2 and 3."

others for special approval or the reverse.

Rule 18. "If it be held that the generic and special names may not be tautonymic, the law of priority will determine whether the special or the generic name should be changed, *e. g.*, *Cossus cossus*, L." The proviso in this case nullifies the rule for us, because we do not forbid tautonymity. Our practice is bad—obviously so, on the score of literary propriety; it is to be strongly discouraged; but it seems an unabatable nuisance, which most naturalists will put up with perforce, and it has one redeeming feature—we know absolutely what every tautonym means.

Rule 19, bringing up 'three classes' of invalid names, is likely to remain a bone of contention in one-third of its scope. We all agree regarding homonymous names, that they are absolutely to be rejected; so, of course, regarding synonymous names. But not so regarding homophonous words, for surely no one of us would reject *Seiurus* because its sound when spoken is identical with that of *Sciurus*.

Rules 20 and 21, hanging on the foregoing, are open to difference of good sound opinion, possibly because, for one reason, it may not be always clear what words come under these provisions. It is desirable, but probably impossible, to have rigid rules here. No rule can possibly be more rigid or stable than the sum of the cases to which it applies; but the cases intended to be covered by Rules 20 and 21 are so shifty and mobile that no seive can be devised with meshes fine enough to catch them all. We confess ourselves puzzled here; we cannot offer better rules than Lord Walsingham has, yet we doubt their sufficiency. It seems to be a case where common sense, tact and expertness may work better than any formality. Let us agree, as most, if not all, ornithologists would, that *Telea* invalidates *Teleia*, and *Pandemos* invalidates *Pandemis;* does *Ucetia* invalidate *Eusesia?* Personally, we should say that would depend upon the etymology in the case. If *Ucetia* be merely a bad way of spelling *Eusesia*, the etymon in the two cases being identical, we should say they were the same word, not available for two names, for all that they happen to be spelled so differently. We would, therefore, spell to the best of our ability both names as one, and use the right spelling or not according to the provisions of some other rule regarding homonyms. But if *Ucetia* and *Eusesia* be of different etymons, only accidentally homophonous, we should regard them as distinct words, neither of which would invalidate the other. Yet we know that others might take exactly the opposite view and argue strongly in its favor. As we said in substance, this whole class of cases has thus far proven refractory to, or elusive of, any rule naturalists have had the wit or ingenuity to devise.

Rule 22. "A name wrongly written is invalid if, on legitimate correction, it becomes homonymous or homophonous with a valid name; *e. g.*, *Grapholitha*, Hb., invalidates *Grapholita*, Tr." The A. O. U. Code would have simply to quash this rule, because it forbids all correction of names, 'legitimate' or illegitimate. We think it is the very worst blot on our Code, which has done more to bring that work into disrepute than all our other weak or bad points put together. It puts a premium on ignorance or carelessness to rule, as we do in Canon XL., that a name shall endure exactly as it originally appeared in print, no matter how mangled it was, unless a *typographical* error be evident. Why be so fierce with the poor compositor, and let the guilty author go scot free? We need not become formal impurists for fear of purism. Personally, we decline to bind ourselves to misspelt words forever, for no better reason than that some zoologists, too ignorant or

too slovenly to spell them properly, sinned in the beginning. We are opposed to 'original sin,' whether as a theological dogma or a canon of nomenclature. On this subject we cite from a private letter lately addressed to us by one of the most learned and distinguished of American philologists, Professor C. P. G. Scott:

"I think you are quite right, as a scholar, in your disapproval of the mechanical rule which, as a member of a committee constrained to compromise, you passively sanctioned in 1886. It seems to me that these verbal uncertainties will *never* end, no matter what committees may recommend or do. Therefore, since the only purpose of compromise is to end uncertainties and discrepancies, it would be better for your committee to revise the code of nomenclature with reference to etymologic principles which *can* be ascertained and stated, and to consider all material deviations, intended or unintended, old or new, as if misprints to be corrected in subsequeut works. Etymologic principles are a good deal more stable and visible than is commonly supposed; but you know by long observation that not every zoologist (particularly in France) is sound in his tackling of Greek and Latin."

Our zeal for 'spelling reform' might not now lead us to the length it did, for example, when we emended Richardson's genus *Aplodontia* into *Haplodon*, only to find, to our dismay, that in its new guise the name was homonymous with several others of prior date, and therefore inadmissible for the genus of mammals. We would treat such a case as incorrigible, and let it go at that, without regard to its etymology. It seems to us that tact, discretion and common sense, applied to each individual case, is likely to work better than any rigid rule which could be devised to cover all cases. We are not such rigid purists as to sacrifice the Law of Priority to purism. In fact, we would not go to the length Lord Walsingham does in '33 *e. g.* (2),' where he 'corrects' *cretidactylus* into *gypsodactylus*. If both these names mean 'chalk-toe,' as we suppose, the substitution of gypsum for chalk, to prevent a Græco-Latin hybrid, seems hardly required. That is mere purism, only less unobjectionable than the systematic impurism which the A. O. U. Code would force upon us. A certain 'sweet reasonableness' would seem to be the best prophylactic or preventive—better than extreme measures either way. Such heroic treatment is likely to become the mock heroism of opera bouffe. As Horace said, some years ago:

> "Est modus in rebus; sunt certi denique fines,
> Ultra citraque nequit consistere rectum;"

and as Professor B. G. Wilder lately remarked, in the course of his controversy with Wilhelm His:

"As with biologic generalizations, there are few philological rules without exceptions. Yet the reformer, especially if young and enthusiastic, either ignorant of history or undismayed thereby, 'too often imagines that a principle, if right, cannot be carried too far.'" (Barclay, 1803.)

Our A. O. U. committee may be neither very young nor over-enthusiastic; yet this is precisely what we have done to the excellent principle of priority—carried it too far, in attempting to impose verbal abortions upon nomenclature. The results sometimes better befit the nursery in their puerility than the halls of science. Take that miserable botch of a word *Leptotila* Swainson for a genus of pigeons. If the celebrated quinarian had printed *Leptoptila*, in proper form, his genus would have been invalidated by the prior *Leptoptilos* or *Leptoptilus* for a genus of storks, because by our rules a difference of termination in words etymologically identical does not prevent homonymity; but because Swainson or his printer did not mind his *p*'s—whatever he

may have done with his *q*'s—*Leptotila* becomes valid and tenable!* This is mere juggling with the letters of the alphabet; it is absurd, undignified, infantile. We should say, first spell *Leptoptila* correctly, according to its obvious formation, and then decide on other grounds whether or not it be in this form different enough from *Leptoptilus* or *Leptoptilos*. Literary abortion should not be viable in the language of science.

Rule 23 allows difference in termination of words to make formal difference in names, *e. g.*, *Sciaphilus* in Coleoptera and *Sciaphila* in Lepidoptera, on the ground that no confusion results. How it would be did these two fall in the same order of insects is not stated. We believe the practice of entomologists has generally been to allow even identical names to coexist in different orders, on the same ground. Probably the latter state of the case is inadmissible in any other branch of zoology; but on the question whether difference of termination or inflection, as indicating grammatical gender, shall suffice to distinguish names, much might be said either way. Our practice is against it. Yet there stand our *Picus* and *Pica*, and we may yet have to reconsider our present canon on this question. Certainly *Leptoptila* and *Leptoptilus* are better distinguished from each other than *Leptotila* would be from *Leptoptila*. One is a distinction with a real difference, viz., of gender; the other is a distinction with a bogus, spurious, bastard, abortive, illegitimate apology for a difference.

Rule 24. "A name which involves a false proposition is invalid and may be changed." One would think this a self-evident proposition in science—a truism, to adult minds, hardly requiring statutory provision. The reverse would be, or should be, unthinkable in science. Yet so far afield in following the *ignis fatuus* of verbal veneration for the fetish of 'priority' have some of our codifiers been led that they would not dare to correct an error of scientific fact for fear of disturbing the cerements of verbiage in which it was embalmed! Let some one describe an albino crow as *Corvus albus*; shall we go on calling black white to the end of the chapter? Let some one describe a broken-billed popinjay as *Picus semirostris*; shall *semirostris* be the name of any species which has a whole beak? Let Gmelin describe a Mexican woodpecker as *Picus cafer*; shall we declare every time we write the name that it is a South African bird? Yet the last is exactly what we do in the A. O. U. Check List, where *Colaptes cafer* stands in a catalogue of North American birds. It is *brutum fulmen* for us to declare that a name has no necessary meaning. Such declarations simply beat the air in a futile and fatuous manner. '*Cafer*' has no meaning for those who do not know what it means, but those who do know what it means can no more divest it of its reference to a South African locality than they can take away from *Colaptes* its implication of carpentering. Granted that we have plenty of nonsense-words in science—mere combinations of letters, *sensu carentes*; granted that we have to put up with them, and that they do very well, like Smith or Jones; that does not make *cafer* mean Mexican, or *albus* mean black. The proposition is false, in form and in fact; and falsity is foreign to science. Any attempt to save the Law of Priority at such hazard, or im-

* We are sorry to observe that the A. O. U. is not consistent with itself, even in wrong-doing. Thus: (1) *Leptotila* is held to be tenable, from lack of the *p*. Had it been *Leptoptila* it would have been untenable, from similarity to *Leptoptilos*. (2) *Fregetta* Bp. is held to be untenable, owing to a prior *Fregata* of Brisson, and *Cymodroma* is used instead. (3) But *Fregetta* is quite as different from *Fregata* as either *Leptotila* or *Leptoptila* is from either *Leptoptilus* or *Leptoptilos*; *i. e.*, there is no real difference in either case. The A. O. U. is wrong in one of these cases, necessarily—which one?

pose uniformity of nomenclature by the arbitrary authority of an individual or a committee who should go to such a length as to say either that words have no meaning or that we shall use words in wrong senses must fail, for the simple reason that common sense will not be coerced, and sensible writers will go on writing as sensibly as they know how.*

Rule 25 provides for expunging from nomenclature any name which is 'offensive (whether politically, morally, or by its irreverence).' This raises a question of great and probably insuperable difficulty; for we may at once ask, offensive to whom? In a certain sense, science is non-political, non-moral (a different thing from being immoral, of course), and non-reverent of anything but ascertained or ascertainable truth. In religion it is agnostic; in printed decencies it is usually found to side with decent people; in political lampooning it might display partisanship as a part of human nature, without great offence to propriety. It would seem to be a case which ordinary self-respect and regard for public opinion would suffice to regulate; yet we can hardly arbitrate it in its nomenclatural aspects. *Sivatherium* might be as offensive to a Hindu devotee of the cult whose god is invoked in the name of a fossil beast as any other blasphemy. Neither *Phallusia* nor *Ithyphallus* offends more than the translations of these terms would in a medical treatise, nor does *Clitoria* keep a manual of botany out of schools. While the drift and purport of Rule 25 are obvious and admirable, its enforcement to the extent of expunging any names but those quite outside the pale of public decency is probably impracticable. The way to deal with such things is to cut the perpetrator the first time he shows himself in society.

*Dr. B. G. Wilder states, Journ. Comp. Neurology, vi., Dec., 1896, pub. Feb., 1897, p. 334: "No such attempt is known to me." Then he never knew the A. O. U. Code and Check List, which are an attempt to secure uniformity of nomenclature by the authority of a committee, "*quorum pars magna fui.*" But his criticism is excellent: "The very notion savors of ecclesiasticism rather than of science. At the most, individuals have set certain fashions, more or less commendable and permanent, while committees have made recommendations which even their own members may disregard when their information is increased or their views are modified."

We have already protracted this review beyond usual limits, and must hasten to cloture. Several following rules bear upon correction of names, orthographically or zoologically. In the former regard they will be nugatory with those who hold to our Canon XL.; in the latter respect they will command the assent of some naturalists, but not of all. Rule 42 will, we imagine, be found decidedly objectionable, as will most of its corollaries; though some of the refinements regarding types may be specially serviceable in microlepidoptera, while less so or not so in zoology at large. In any event, Walsingham and Durrant have given us in this Code a notable contribution to the literature of the subject, which can be studied to advantage by every zoologist, perhaps by every botanist also. For ourselves, we are among a large number of naturalists who are fully convinced that the A. O. U. Code is, on the whole, by far the best one ever formulated. Our appreciation of its manifold good qualities and general utility leads us not unnaturally to set it up as a standard of excellence with which other codes are to be compared. That we are not blind to its defects is obvious from what has preceded; but it is our very conviction of its strength and worth which makes us feel free to express ourselves perhaps more forcibly regarding its blemishes than we should if we considered it a weak or tender thing that needed nursing. At the same time it were idle to consider our Code a faultless finality; no sensible man is going to be bound by it against his own convictions, and if naturalists are ever to be

blessed with such a thing as an infallible rule of faith and morals in matters of nomenclature that state of beatitude may be sought along the line of one of Lord Walsingham's suggestions: "All branches of zoological study should undoubtedly be represented on any committee entrusted with the task of drawing up rules for general guidance." Pending any final consummation, British ornithologists will no doubt continue to lean upon Strickland and the B. A. Code. American ornithologists, and most zoologists of this country, will stand by the A. O. U. Code; while doubtless the Merton Rules will be respected by most of those entomologists whose requirements are so ably met in this instance.

Elliott Coues.

As said above, the 'Merton Rules' agree in the main, or at least on most points of leading importance, with other recently promulgated Codes of Nomenclature; but they embrace many provisions, by no means all new, which are open to strenuous objection, on the ground that they seriously militate against the stability of names in zoology. Some of these have been pointed out in the foregoing review; others have been passed over leniently or quite unnoticed. On the other hand, some which we consider utterly objectionable have received approval.

Rule 5, for example, provides that "The same name may be used once only in the same grade, with the exception of special [specific] names, so long as they occur in different genera, and of subspecial [subspecific] names so long as they are subservient to different species." Since 'subspecial,' or subspecific, names are often applied to forms of uncertain status, and may be regarded either as species or subspecies by different writers, it is obvious that they should fall under the same rule as 'special,' or specific, names. Otherwise they are open to instability, according to whether the forms to which they may be applied may be regarded as 'species' or 'subspecies' by different authors.

Rule 19 divides 'invalid names, considered merely as words,' into three classes: (1) *Homonymous*, (2) *Homophonous*, and (3) *Synonymous*. 'Homophonous' words are 'words differently written, but indistinguishable in sound, applied to different conceptions.'

Rule 20 provides that "A name homophonous with a valid name is invalid, in accordance with the rule governing homonomy (Rule 5)." (See Rule 5, as quoted above.) This we regard as a pernicious in-innovation. Previous codes advise that in selecting new (especially generic) names those closely resembling previous names in orthography or sound be avoided; but this is the first instance, we believe, where they have been declared invalid. The objections to this rule are: (1) that scientific nomenclature belongs properly to written language, not to spoken language; (2) that whether a name is or is not too near in sound, when properly pronounced, to another earlier name must be largely a matter of opinion, respecting which authors must frequently disagree; this disagreement being necessarily a fruitful source of instability in names. It opens a loophole for the displacement of well-known names by new ones on the ground of personal opinion or preference, perhaps biased by the opportunities thus presented. In all languages there are almost innumerable homophonous words of radically different origin and meaning; why should they not be admissible in the language of science?

Rule 20 is thus in opposition to the intent of nearly all modern codes, which are designed to leave as little as possible open to the notoriously unsafe decision of personal judgment or option in matters of nomenclature.

According to Rule 21, which is an amplification of Rule 20, a name may be only 'so similar to a valid one as to be *almost homophonous*' to be rejected, which, of course, but emphasizes the objections already made to Rule 20.

It follows that Rule 22 is also objectionable (1) in that it provides that "a name wrongly written is invalid if, on legitimate correction, it becomes (either) homonymous or homophonous with a valid name;" and (2) in that it implies the right of emendation of names.

Yet Rule 23 permits, in the case of genera, the use of names which differ merely in 'a different sexual suffix,' as in cases like *Sciaphilus* and *Sciaphila*, in opposition to previous codes and the consensus of probably nine-tenths of present zoological writers. The case of *Picus* and *Pica* is obviously not parallel, inasmuch as these names have come down to us from pre-Linnæan classical writers, who employed them, not interchangeably, but as names for entirely distinct objects. The etymology of these words is admittedly unknown, but their use for centuries as distinct names, applied to totally unlike birds, seems sufficient reason for their use in modern systematic nomenclature, and for their adoption as distinct words, despite the accident of their similarity.*

Rule 24. "A name which involves a false proposition is invalid and may be changed." Note first the use of 'may' instead of *must*, leaving the enforcement of the rule optional, and thus opening a way to instability of names through mere personal opinion or preference. Note, secondly, that it opens the way to wholesale changes on trivial grounds. If a species of a certain genus has been named *minimus* or *major*, and a species is subsequently found that is smaller or larger, the names in question 'involve a false proposition.' And so in cases where names relate to color, as where a species is named *nigra*, or *purpurea* or *rubra*, and is not of the color implied; or in the case of species given geographical names that do not occur in the countries whose names they bear, or in other cases indicate portions of their range which are not characteristic of their distribution. For instance, a Mexican species may have been named *brasiliensis*, or a Peruvian species *cayennensis*, which do not occur respectively in Brazil or Cayenne. This class of cases, as everyone knows, is legion. To avoid the adoption of a rule necessitating such sweeping subversion of names we can well afford to endure the isolated case of a name like *cafer* for a North American woodpecker! *Ludovicianus*, as applied to one of our tanagers, now 'involves a false proposition,' since the species does not occur in Louisiana. There is, in fact, every shade of falseness in names, from a time-honored *Paradisea apoda* to such as involve a falsity so slight as to be of questionable importance in the mind of even the greatest stickler for nomenclatural veracity.

Rule 27 is the corollary of the principle laid down in the 'introduction' regarding the 'guarding' of the 'actual work and *intention* of an author,' quoted, and so emphatically commended in the foregoing review of the 'Merton Rules.' The Rule is: "The right of an author to correct antecedent work is undoubted, provided always that in making such corrections the *intentions* of his predecessors be respected, unless proved to be erroneous." This is an innovation fraught with the gravest possibilities for mischief. Heretofore it has been deemed to be the only safe course to take an author's work as he left it, without attempting to

*Since this was written this point has been touched upon in this journal (SCIENCE, N. S., Vol. V, No. 126, May 28, 1897, p. 847) by Dr. Stejneger, who says *Picus* and *Pica* "are distinct and separate Latin classical names for widely different birds, though the philological root of the two words is probably the same."

guess at what he intended to do, even if in rare cases we may be compelled to ignore an obvious intent. The trouble here is that when the bars are let down there is no limit to the license authors may take, for one reason or another. The case of *Dendragapus*, cited above as an illustration, shows to what strange conclusions such license may lead. It is purely a matter of opinion whether *obscurus* and *canadensis* are generically separable. For those who think they are not, the only course open is to treat them as members of one genus, and to take the oldest tenable name available for the group, in accordance with a fixed principle of nomenclature especially provided for such emergencies. The first tenable name happens in this case to be *Dendragapus*. If this is 'puerile, unscientific and immoral,' there is no help for it, even under the 'Merton Rules.' All it amounts to is a difference of opinion between ornithologists as to the value of the differences which distinguish the two species *obscurus* and *canadensis*.

Rule 30 provides, among other things, that "an orthographical correction may be made by emending a name wrongly formed." This is not an innovation, as the same provision is found in other codes. But it is diametrically opposed to Canon XL. of the A. O. U. Code, which provides that "the original orthography of a name must be rigidly preserved, unless a typographical error is evident." Sound and weighty reasons are given in the A. O. U. Code for its adoption ; it is in accord with the practice and advice of many eminent authorities—some of whom lived before the A. O. U. Code was thought of, and were scholars as well as naturalists; and, while still repellant to some, it is obviously gaining ground, as there is an increasing number of writers who consider fixity of names as of higher importance than the correction of grammatical or philological imperfections in their construction. Not only is this view shared very generally by American mammalogists, but we have recently found that it has strenuous advocates among eminent specialists in other departments of zoology, notably in entomology.

When we consider that purists and classicists are often at loggerheads among themselves over the emendation of a name; that names are often 'emended' out of all resemblance to their original form and become, to all intents and purposes, new words; that, when less modified, the initial letter is often the part affected, and that through this change the name takes a new place in all indexes and in all alphabetic lists where it appears, resulting in an inconvenience of serious magnitude—it seems far the lesser of two evils to put up with here and there an orthographic abomination than to sacrifice stability of nomenclature to philological refinement. Carelessness or ignorance in the construction of names is to be deprecated and frowned upon, as it is in the remarks under the much abused Canon XL. of the A. O. U. Code, which, therefore, does not place 'a premium on ignorance or carelessness,' but simply chooses by far the lesser of two evils. It conforms to the whole spirit of the Code, which aims at stability in names, and the elimination of every element of instability that may arise from personal preferences in matters where opinions must inevitably differ to a greater or less extent. Even my fellow critic of the Merton Rules cannot agree with Lord Walsingham as to the extent emendation is allowable, as in the above-cited case of changing *cretidactylus* to *gypsodatylus*.

As to the case of *Leptotila*, dwelt on at length above, if 'tales out of school' were admissible, the inside history of its adoption by the committee would afford an amusing commentary on some of the remarks above made. Suffice it to say that

as *Leptotila* was repeatedly used by Swainson, and thus with obvious intent, it could not be ruled out as an 'evident typograhical error' for *Leptoptila*, and so was accepted as simply a name, and therefore available under the A. O. U. maxim, "A name is only a name and has no necessary meaning;" or, to cite the B. A. Code of 1842, "In truth, it matters not in the least by what conventional sound we agree to designate an individual object, provided the sign to be employed be stamped with such an authority as will suffice to make it pass current." It is, therefore, entirely thrown out of the category of such cases as *Fregetta* and *Fregata*, discussed above.

It certainly is to be hoped that all sensible writers will go on writing as 'sensibly as they know how;' but in the above remarks on *cafer* and *Leptotila*—ostensibly anent the 'Merton Rules,' but really in ridicule of the A. O. U. Code—it is evident that not all of the 'puerility' is on the side of the supporters of Canon XL.

Nos. 34–37 of the Merton Rules call for no comment, being in essential conformity to current usage. We must dissent, however, from Rule 38 in so far as it relates to 'co-types,' this part being to the effect that when a species is 'described from more than one specimen, no single one being selected as the type,' the 'type' in this case is 'the sum of the co-types.' The position here taken seems so obviously unwarranted as to hardly merit discussion.

Rules 42–48, on the restriction of genera, are refinements of existing rules relating to this subject, treating the matter in detail on lines already for the most part generally approved.

Rule 49 provides a most cumbersome way of designating subspecies. Rules 50 and 51 relate respectively to the use of signs and methods of citation, the latter formulating practices already more or less in vogue.

As already said, the 'Merton Rules' are in the main in accord with other advanced modern rules and usages; the innovations, as noted above, are for the most part positively mischievous, from the standpoint of fixity in names; the adoption of the tenth edition of Linnæus's 'Systema Naturæ' we regard as the one especially commendable feature of this new code, only so, however, on account of its geographical origin, since all recently promulgated Codes take this date as the starting point for the law of priority.

J. A. ALLEN.

THE ORIGIN OF GREEN RIVER.

IN his Current Notes on Physiography in No. 121 (April 23d) of this JOURNAL, Professor Davis, under the heading: 'Is Green River antecedent to the Uinta Mountains?' remarks that this question is not closed, as had been assumed by Mr. J. D. Irving in his paper on 'the Brown's Park beds of Utah,' and further that it does not appear clear from the latter's statements whether he considers it to be a superposed river, as maintained by me, or antecedent, as stated by Powell. He very pertinently remarks that it is remarkable, considering how frequently the Green is referred to as an antecedent river, that so little attention is given to the difficulties that such origin involves. Long before the appearance of the two textbooks he quotes (Tarr and Scott), LeConte and Geikie had each referred to it as antecedent and illustrating the slow uplift of mountain ranges, in apparent unconsciousness that any other view is possible. Suess, on the other hand, in his exceedingly careful review (Antlitz der Erde, I., p. 736) of the structure of this region, adopted my view without any reference to that of Powell.

In Powell's original publication (Exploration of the Colorado river of the West, p. 153) he makes no mention of the struc-

tural difficulties the river might have to contend with, but contents himself with the simple statement: "The river had the right of way; in other words, it was running ere the mountains were formed; not before the rocks of which the mountains are composed were deposited, but before the formations were folded so as to make a mountain range." Later he remarks: "I reserve the subject for a more full discussion in my report on the geology of the Uinta mountains." In this report, however, I had been able to find no mention of the subject whatever, and I had assumed that upon further study he had found the difficulties in the way of his theory too great to be explained away.

My study of the region was made in the summer of 1871. Powell continued his during the years 1874 and 1875, after, at his request, I had explained to him my views as to the structure of the range.

Upon the following facts with regard to its geology we are both agreed. The uplift of the Uinta Arch commenced at the close of the Cretaceous. During Tertiary times there were deposited in the lakes, which washed either flank of the range, not less than 8,000 feet of sediments that were derived, in part, at least, from the degradation of that Arch.

Now, as my map shows, these Tertiary beds, overlapping in a nearly horizontal position the upturned and truncated edges of the various formations composing the original arch, reach altitudes of 9,000 and 10,000 feet at various points along either flank of the western and higher portion of the range. The eastern portion of the range, through which the peculiarly winding cañons of the Green River have been cut, has an elevation of only 7,500 to 8,500 feet, a few of the higher points reaching 9,000 feet, and in one case 9,297 feet.

According to Powell's theory, however, the river had determined its course before the uplift of the arch, and has continued to occupy the same bed to the present day. "The principal cañons through the mountains," he says, "had been carved nearly to their present depth before the last of these sediments were deposited."

What, then, became of the river while these 8,000 feet of Tertiary sediments were being deposited? It could hardly have continued its course at the bottom of the Tertiary lakes while the sediments were depositing. But if it ceased to flow during this time its bed must have been filled with sediments as well as the rest of the country, and when the lakes were finally drained, it is hardly conceivable that, in redetermining its course across the 150 miles of Tertiary beds on the north side of the range, it should have attacked the flanks of the Uinta range, themselves partially buried, at exactly the same point it had entered before.

There are many other features that require explanation before Powell's hypothesis can be accepted, one of which Professor Davis has pointed out in the Brown's Park depression, a longitudinal valley 40 miles long and 5 to 6 miles wide, open only at its eastern end, and nearly in the axis of the range. It is supposed to have been formed by engulfment, and has twice been occupied by Tertiary waters, once in Eocene, and once in Miocene or later times.

How the river kept its course (which three times wantonly leaves the open valley to cut cañons in its hard walls) through all these vicisitudes, would seem to require a more direct explanation than that "The river preserved its level, but the mountains were lifted up, as the saw revolves on a fixed pivot, while the log through which it cuts is moved along."

Inasmuch as the promised discussion did not appear, I have recently asked Major Powell to explain to me his conception ot how these things could have been accom-

plished, but he says it is so long ago he no longer remembers the course of reasoning he followed at the time.

I assume that Capt. C. E. Dutton, who at Powell's request took up and completed the latter's Colorado cañon geology, is likely to have voiced his matured opinion on this point. In his paper on the Grand Cañon (2d Ann. Rep. Director U. S. Geol. Survey, p. 62), in treating of the persistence of rivers, Dutton gives a most graphic description of the course of the Green river in its passage through the Uinta mountains. In spite of the fact that he places Horseshoe Cañon on the south instead of on the north flank of the mountains, it is evident that he must have read Powell's description, for he uses not only his metaphor about the 'right of way,' but also the simile of the saw preserving its position while the log moves. Whether consciously or not, however, he certainly does not agree with Powell's hypothesis, for he says in conclusion: "What then did determine the situations of the present drainage channels? The answer is that they were determined by the configuration of the surface existing at or very soon after the epoch of emergence. Then, surely, the water courses ran in conformity with the surface of the uppermost (Tertiary) stratum."

Dutton elsewhere states more definitely that the course of the Green or Colorado river south of the Uinta mountains was determined at the close of the Eocene. If this is correct, I was probably wrong in assuming that the Green river first found its way across the Uinta mountains after the Wyoming (Bishop's Mt.) conglomerate had been deposited, because I found undisturbed remnants of this formation on either side of the river, both on the north and south flanks of the mountains and at such elevations that, if the beds were continued across the intermediate country on the same level, they would completely cover that portion of the mountains through which the Green river now runs. I have for a long time been hoping and still hope that some other geologist may make a more thorough examination than I was able to at that time, and determine the nature and extent of this singular formation, which has never been satisfactorily accounted for. Whatever may be the outcome of such an examination, it would seem proper that the antecedent origin of this river should be held in abeyance until some positive evidence of it can be furnished.

S. F. EMMONS.

U. S. GEOLOGICAL SURVEY.

ZOOLOGICAL NOTES.

THE SCIENTIFIC NAME OF THE VISCACHA.

ONE of the best known mammals of the pampas of the Argentine Republic is the viscacha, now usually called *Lagostomus trichodactylus.* Unfortunately this name proves to be untenable, but in order to show that such is the case it will be necessary to refer briefly to the history of the species. The animal was first described in 1801, by Azara, who considered it identical with *Cavia acuschy* of Gmelin, which is now known to be an entirely distinct species. Rafinesque, in 1815,* proposed the genus *Viscacia,* apparently without description, so that his name is not entitled to recognition. One year previous, in 1814, according to Waterhouse (Nat. Hist. Mamm., Rodentia, 1848, p. 213), a living viscacha was placed on exhibition in London,† where it was examined by Blainville and Cuvier. Blainville soon after described the species as *Dipus maximus.*‡ Some years later the same animal came into the possession of Brookes, a member of the Linnæan Society of London, who gave a full description both of its

* Analyse de la Nature, 1815, p. 56.

† Burmeister states that there were two.

‡ Nouv. Dict. d'Hist. Nat., nouv. éd., XIII., 1817, pp. 117–119.

skeleton and of its external characters in a paper read before the Society on June 3 and 17, 1828.* Brookes recognized the fact that the viscacha belonged to a distinct genus which he named *Lagostomus.* He also changed Blainville's specific name *maximus* to *trichodactylus* on the ground that it became inappropriate in connection with a genus represented by only one species. Authors who have adopted *Lagostomus trichodactylus* have reduced *Dipus maximus* and other subsequent names to synonymy, but, almost without exception, have overlooked one of the most important references to the species.

In 1824 Schinz began the publication of his 'Naturgeschichte und Abbildungen der Saugethiere,' and on page 244 of this work gave a full description of the viscacha, calling it *Vizcacia pamparum.* A comparison of the title pages of this work (1824) and of volume XVI. of the Transactions of the Linnæan Society (1828) seems to indicate that *Vizcacia pamparum* Schinz has 4 years priority over *Lagostomus trichodactylus* Brookes. Although Schinz's name was undoubtedly published first, its actual date of publication is uncertain. Schinz's Naturgeschichte appeared in 29 Hefte, at intervals from 1824 to 1828, and, as the description of the viscacha is inserted near the middle of the book, it was probably not published before 1825 or 1826. I have been unable thus far to ascertain the dates of publication of the separate parts of the Naturgeschichte, but in the copy examined is a notice to subscribers, printed for distribution with the 29th Heft, and dated February 28, 1828, stating that this is the concluding part of the volume. Schinz's work was evidently completed several months before Brookes' paper was even read, and possibly a year before it was actually published, if we accept the statement in Oken's Isis (1830, p. 906) that the latter appeared in 1829.

Vizcacia therefore, is, probably not less than 2 years earlier than *Lagostomus*, and, as the objection to Blainville's specific name would not be considered valid by modern zoologists, the species should stand *Vizcacia maxima* (Blainville).

T. S. PALMER.

WASHINGTON, D. C.

* Trans. Linn. Soc. London, XVI., pt. I, pp. 95–104, 1 plate.

CURRENT NOTES ON PHYSIOGRAPHY.

BOSPHORUS, RHINE AND HUDSON.

PHILIPPSON'S 'Geologisch-Geographische Reiseskizzen aus dem Orient' (Sitzungsber. Niederrhein. Gesellsch., Bonn, 1897) include, among many other items of interest, a clear account of the Bosphorus as a partly drowned valley incised in an uplifted peneplain of deformed Devonian strata. Viewed from the summit of Bulgurlu, a low quartzite monadnock that surmounts the upland east of Skutari, the peneplain, only here and there interrupted by rounded knobs and ridges, is seen to ascend slowly northward, and then to rise in a marginal ridge of harder strata along the border of the Black Sea. The upland is generally unoccupied, being rather barren, in part from natural infertility, in part from exhaustion of the soil such as characterizes the vicinity of nearly all the great millenial cities of the Mediterranean. The Bosphorus trench has a winding course, the water surface being 200–300 met. beneath the upland. The water is generally 50 met. deep, but becomes shallower near Constantinople, as if by the washings and waste from that old city. Philippson justly compares the gorge of the Bosphorus to that of the Rhine. A still closer analogy might be found with the gorge of the Hudson, since the latter is a drowned river, deep and navigable to large vessels, while the Rhine is a running river, comparatively shallow in the gorge and interrupted by rapids and islands.

Speaking of the Rhine, mention may be made of a geological essay by Rothpletz, of Munich (Das Rheinthal unterhalb Bingen, Jahrb. k. preuss. geol. Landesanst., 1896, 10–39), in which it is shown that for about four kil. in the head of the gorge it follows close upon a narrow block between two sub-parallel faults of considerable dislocation. Although no vertical movement is proved for the block, the author concludes that there was a 'direct genetic connection' between the dislocation and the origin of the gorge, for similar disturbances seem to be wanting in the uplands (Taunus) further east. It may, however, be objected that until the date of the dislocation is shown to be recent, and until the movement of the block is shown to be downward, it is premature to make too close an association of these two phenomena. If, as is very possible, the dislocation is ancient, all sorts of happenings may have intervened before the river gained its present course; and among the factors that determined its location, the dislocation may have had a relatively subordinate rank. To place ancient structural disturbances in direct genetic connection with the location of a very modern river gorge suggests that a great many intermediate processes are overlooked.

THE GEOGRAPHY OF BRITTANY.

PROFESSOR CHARLES BARROIS, of Lille, long occupied on the intricate geology of Brittany, has recently presented a summary of its geographical divisions, with a special chapter on the influence of its physiography on its advance in civilization (Ann. de Geogr., VI., 1897, 23–64, map). The region is composed of ancient rocks, strongly folded and dislocated on east and west lines, whose trend diverges inland. To-day the surface is that of a dissected peneplain, with even skylines and a gradual descent to the north and south, the former steeper than the latter. The author believes that the ancient mountains indicated by the structure have been removed by subaërial weathering and washing, not by marine erosion. The existing longitudinal drainage lines do not occupy synclinal axes, but follow open valleys or *combes* along the strike of weak strata, after the fashion of subsequent streams. The transverse rivers, by which the inner belts of low ground are drained, cross the uplands in sharp trenches or *cluses*, across which viaducts and suspension bridges are carried above the steeples of the valley villages. These transverse streams are called *consequent*, as if determined by the lateral slopes of the original deformation (post-Carboniferous); their possible origin by superposition from a Mesozoic cover, now stripped away, is not explicitly considered. In this respect the suggested comparison of the drainage on the ancient folded structure of Brittany with the rivers of the relatively young and simple dome of the English Weald does not seem to be fully warranted.

INSEQUENT RIVERS.

INITIAL land forms, due to uplift, deformation and other non-destructive processes, are gradually carried through a systematic series of sequential changes, chiefly under the action of streams, sometimes under the action of waves, wind or ice. Omitting antecedent streams from present consideration, the first streams to be developed on an initial surface are the *consequent* streams, so named by Powell. If the valley sides of the consequent streams lay bare a disordered structure of variable resistance, gullies and ravines will grow along the guidance of the weaker structures, and thus *subsequent* streams will be developed by headward erosion; the term *subsequent* being first used in this connection by Jukes, although not in a technical sense. It sometimes happens that no guiding weak structures are revealed on the consequent

valley sides; such being the case when the rocks are either homogenous or horizontally stratified. Then the side streams, growing headwards, are accidentally located; and streams of this class have been called *autogenetic* by McGee. *Insequent* may prove to be a more satisfactory name for such streams, as it is of the same etymological family as *consequent*, *subsequent* and *obsequent;* the latter being defined in the *London Geographical Journal*, V., 1895, 134. As *insequent* has proved servicable in my lectures during the past winter, it is now submitted for trial by others.

NEW TERMS IN GEOLOGY AND GEOGRAPHY.

WITH a protest against the introduction of new terms in geology as a rallying cry, a good friend of all geologists has unfurled his banner to the breeze in a recent number of SCIENCE, as if inviting those who are of his opinion to enlist in a crusade against a threatened inundation of scientific verbiage. Those holding other opinions may prefer to enlist in friendly opposition in another camp, under the leadership of a geologist who said some years ago that he felt he had accomplished a good piece of work by introducing a new name for certain deep-seated igneous structures. For one, I dissent entirely from the dictum that new terms are 'evidently nothing more than a useless incumbrance to the science' of geology. New terms are an absolute necessity in any science that is advancing. Useless terms are of course objectionable, but who shall say which are the useless ones? New things and new ideas must have new names. There is too much good new wine to be held in old bottles. 'The common run of educated people in this country' are entirely excusable if they know nothing of such new terms as monadnock and peneplain, or of such older terms as novaculite and bauxite; for their ignorance and their opinions are irrelevant in technical matters. The investigator and the specialist must be left as free to name their conclusions as to reach them; and they, much better than any one else, can judge of the need of new names. By all means, let them be cautious and avoid unnecessary names; but unless they can number their new finds, as astronomers number new asteroids and new comets, they must name them. Having invented a new name, they may well let it take its chances in the struggle for existence. If it prove acceptable to workers in its field, it will take root and flourish; if not, it will soon wither away and be seen no more. As far as new terms in physiography are concerned, I have had a good share of amusement in watching the fate of certain words that have appeared in recent years. Some have survived and some have perished. Among several that appear to be destined to survive, although not generally used at present, let me commend 'subsequent,' 'adjusted' and 'graded' (ordinary words used in a technical sense), 'obsequent' and 'insequent' (new-made words of English form), and 'doab' and 'cuesta' (imported foreign terms), to the attention of those who maintain that new terms are evidently nothing more than a useless incumbrance to a science. It will be interesting to note the standing of these words ten or twenty years hence. The amount of attention given then or now by teachers and students to physiography—or geomorphy, as some neologists would call it—may be measured by the terseness and precision with which they express the ideas or things represented by these words and their fellows.

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CURRENT NOTES ON ANTHROPOLOGY.

CENTRAL AMERICAN CARIBS.

THE Caribs, who spread so widely over South America, never reached any part of

North or Central America in pre-Columbian times, so far as we know. About a hundred years ago the English deported a large number of them from the island of St. Vincent to the island of Ruatan, in the bay of Hondnras. In the century which has since elapsed they have spread extensively over Central America, retaining largely their language and traits.

An interesting sketch of them is given by Dr. Carl Sapper, in the 'Internationales Archiv für Ethnographie,' Bd. X. The changes in their dialect by loss of forms and the introduction of new words from various European tongues are numerous, but its affinity to the Carib of the islands is unmistakable. Their arts also are South American.

The latter feature is further illustrated by an article from the pen of the editor of the *Archiv*, Dr. J. D. E. Schmeltz, on the utensils of the Caribs of Surinam, Dutch Guiana. It has an especial interest as tracing the development of the bird-motive in Caribbean art products. Several colored plates explain to the eye the descriptions in the text.

THE ANTHROPOZOIC FORMATION.

THE strata in geologic deposits which include the remains of man are called 'the anthropozoic formation.' To divide this accurately, with reference to sequence of time, on the one hand, and development of culture, on the other, is a leading task of the anthropologist. Professor Woldrich, of Prague, has proposed a scheme for the area of central Europe, which is published in the 'Centralblatt für Anthropologie,' 1897, Heft 2. It is useful as a general standard and it merits an epitomized reproduction here.

The Anthropozoic Formation.

I. The Diluvial Epoch.
  A. Palæolithic period.
    1. Preglacial.
    2. Glacial and Interglacial.
    3. Post-glacial.
  B. Mesolithic period.
II. The Alluvial Epoch.
  C. Neolithic period.
    1. Old or atrymolithic (no bored stones).
    2. Middle or trymolithic (bored stones begin).
    3. Late, with the stones dressed to art shapes.
  D. Metallic Period.
    1. Bronze age.
    2. Iron age.
    3. Protohistoric age.
    4. Historic age.

The author adds numerous examples of these several divisions from the layers of central Europe, and further specifications of their characteristics. He dismisses the 'hiatus' between the palæolithic and neolithic maintained by some archæologists, believing the development to have been gradual and uniform.

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NOTES ON INORGANIC CHEMISTRY.

THE statement is frequently found in the text-books that when platinum-silver alloys are treated with nitric acid a considerable quantity (5–9%) of platinum follows the silver into solution. In the Proceedings of the Chemical Society Mr. John Spiller gives the results of experiments on such alloys, containing from 0.25 to 12% platinum. In dilute nitric acid (1.2 sp. gr.) only about 0.25% of platinum was dissolved; with ordinary concentrated acid (1.42 sp. gr.) the maximum platinum dissolved was 1.25% and the average 1%. It thus appears that the ordinary statement is incorrect.

PROFESSOR RAMSAY recently read a paper before the Royal Society, detailing a series of experiments which show that helium

and argon do not pass through red-hot septa of platinum, palladium or iron. It is well known that hydrogen passes with great ease through such septa, either owing to solubility in the metal or the formation of easily decomposable compounds. Professor Ramsay's experiments imply the inability of helium or argon to form any even unstable compound with these metals or to dissolve in them at red-heat, another evidence of the inertness of these gases.

The following from the *Chemical News* deserves to be quoted in full: "Atomic Models (Patent No. 1999, 1897). A patent has recently been granted to Mr. Frederick George Edwards, of London, by which the government affords protection to his idea that all atoms can be represented by varying numbers of tetrahedrons. The germ of the idea appears to be that as there are about seventy elements known to chemists, and that the tetrahedrons can be grouped together in as many as seventy different ways, the latter can illustrate the former. This is the idea; the practice, the inventor shows, is not so simple. For instance, he says: 'Regular tetrahedrons do not fit exactly, but each tetrahedron is so nearly regular that it may be supposed that each of the elements were (*sic*) created from regular tetrahedrons in a plastic condition.' This strikes us as a beautiful example of inventing facts to fit a theory. We are glad to find that Mr. Edwards has not patented atoms *per se*, but merely the form he thinks they take, together with a few names of elements, hitherto undiscovered, but predicted by him. These are: icosagon, atomic weight, 10; *x*-odine, atomic weight, 215; and zadmium, atomic weight, 245. It will be interesting to watch the action for infringement of patent which will result if any chemist engaged in research should have the temerity or the misfortune to discover either of these predicted elements. A lithographed diagram at the end gives the *shape* of thirty-two elements, with atomic weights made to fit; we are sorry to have to record the fact that many of these atomic weights are wrong, but then so probably are the shapes."

The *Chemisches Centralblatt* gives an abstract of a lecture by L. Wenghöffer, of Berlin, on the incandescent (Welsbach) gas-light. Among many points we note the following: Auer von Welsbach is not the original discoverer of the incandescent light, but deserves the credit of having brought the light to its present perfection and made it an industrial success. The oxids for the mantles must be chosen with great care, as well as their proportions, to attain the maximum brilliancy. The best results are reached with about 99% thoria and 1% ceria. The presence of any other of the rare earths does not improve the light, and a greater or lesser proportion of ceria is detrimental. 'Russium' nitrate, the use of which has been recommended in the place of cerium, proved in one case to be a mixture of thorium nitrate with much cerium nitrate, and in another case to be a mixture of cerium and ammonium nitrates. 'Lucium' oxid is impure yttria. The best source of thoria is monazite sand, and the price of thorium nitrate has fallen from $500 per kilo at the opening of 1895 to $5 or less at present. The cause of the low price is competition, and there is no probability that the supply will diminish. The source of the cerium is the by-product of the thorium manufacture, and the price of its nitrate is steady at about $50 per kilo. The bath for saturating the mantle is a 30% aqueous solution of thorium and cerium nitrates in the proportion of 99 : 1.

From experiments on the action of ammonia on mercurous iodid, Maurice François, in the *Journal de pharmacie et chimie*, is led to the belief that the dark product formed by the action of ammonia on calomel is not a mercuro-ammonium compound, as has been

supposed, but a mixture of the colorless mercuri-ammonium compound with very finely divided metallic mercury.

N. TARUGI, who introduced the use of thioacetic acid as a substitute for hydrogen sulfid in the laboratory, has, in the *Gazzetta chimica italiana*, a study of the action of thioacetic acid on salts of bismuth. The thioacetate of bismuth is decomposed by a small amount of water with the formation of a thiobasic salt $(CH_3COS)_3$ BiS, and this on treatment with sulfuric acid gives a sulfate $(CH_3COS)_3$ Bi SO_4, and on treatment with iodin the corresponding iodid. These new compounds are of interest as being the first compounds of quintivalent bismuth in the marsh-gas series.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE Senate has agreed to the provisions in the tariff bill admitting free of duty books in print more than twenty years, books in foreign languages and such as are devoted to scientific research, and books and scientific instruments imported for public and educational institutions.

PERHAPS the most noteworthy additions to the United States National Museum during recent years have been the rich collections of pre-historic pottery, made in the pueblo region, during the last two seasons, by Dr. J. Walter Fewkes, of the Bureau of American Ethnology. The success attending his operations in the past has led to a provision for continuing the work, and he has recently set out to the field for the third time. His design is to survey and excavate the ruins known among the Indians as Kintiel, near Navajo Springs, Arizona. He is accompanied by Dr. Walter Hough, of the United States National Museum.

THE keen appreciation of the importance of research on the part of Secretary Wilson has already given fresh impetus to various lines of scientific work in the Department of Agriculture. The more important operations are carried forward without change of personnel; it seems to be the policy to maintain and strengthen the bureaus built up through the zeal and ability of well-known scientific men; and, at the same time, scientific character is given to certain of the lines of work hitherto regarded as administrative. One of the recent changes is the appointment of Mr. John Hyde as Statistician of the Department. Mr. Hyde became widely known through his connection with the Eleventh Census, and he has more recently been known in scientific circles as editor of the *National Geographic Magazine* and as a writer on political economy.

MAJOR J. W. POWELL is on the coast of Maine, engaged in researches concerning shell mounds, in the interest of the Bureau of American Ethnology.

PROFESSOR SOUILLARD, astronomer at Lille, has been elected a corresponding member of the Paris Academy of Sciences.

DUBLIN University has conferred the degree of D. Sc., on Professor William Ramsay, Major P. A. M'Mahon, D.D., and Professor Wilhelm His, of Leipzig.

DR. RUDOLPH LEUCKART and Dr. Karl Neumann have been made Knights of the Prussian Order of Merit in Science and Art.

THE Royal College of Surgeons of England has conferred the John Tomes prize on Mr. C. F. Tomes, F. R. S.

THE *Naturwissenschaftliche Rundschau* states that, at a recent meeting of the Academy of Sciences of Vienna, Ritter v. Arneth was reëlected President; Dr. Suess, Vice-President; Professor Huber, General Secretary, and Dr. Hann, Secretary of the Mathematico-Physical Section. Dr. Gautsch v. Frankenthurm and Dr. Exner, of Innsbruck, were elected corresponding members; Lord Lister, honorary foreign member; and Dr. Vogel, of Pottsdam; Herr Karpinsky, Director of the Geological Institute of St. Petersburg; Dr. Gegenbauer, of Heidelberg, and Herr Brioschi, of Milan, corresponding members.

M. LE GÉNÉRAL DE TILLO announced at a recent meeting of the Paris Academy of Sciences that the sum of 25,000 francs had been subscribed in Russia to the Lavoisier monument fund.

M. Falguières has been commissioned to design the Pasteur statue to be erected in Paris, for which 297,000 francs has been subscribed.

The United States Civil Service Commission will hold an examination on July 20th to establish a register of eligibles for the position of industries in the Indian school service. The subjects of the examination will be penmanship, spelling, methods of manual training, arithmetic, geometry, geography, industrial economy, mechanical or industrial drawing (one optional), free-hand drawing and physics. There is a vacancy at the Indian school at Perris, Cal., the salary of which is $840 per annum.

We regret to record the deaths of DeVolson Wood, professor of mechanical engineering at the Stevens Institute of Technology, Hoboken, New Jersey, on June 27th, at the age of sixty-five years; of Professor Julius von Sachs, on May 29th, at the age of sixty-five years; of the Rev. Alexander Freeman, on June 12th, at the age of fifty-eight years. Mr. Freeman was at one time deputy for the Plumian professorship of astronomy at Cambridge, and was a fellow of the Royal Astronomical, Mathematical and Physical Society; of Dr. Peter Von Tunner, at the age of eighty-nine. Dr. Von Tunner founded, in 1840, the school of mines at Leoben, in Styria, and was the author of many contributions on the metallurgy of iron and steel.

The London *Times* reports that Dr. Wölfert and an assistant named Knabe were killed on June 12th while making trial of a navigable balloon invented by Dr. Wölfert. The balloon was being exhibited at Berlin before the officers of the ballooning section of the army, when the gas was ignited by the benzine used in the motor.

Commissioner Herrmann, of the General Land Office, has, it is said, submitted to the Secretary of the Interior a report regarding the rules and regulations for the government of the forest reserves, with special reference to the parts available for mining, grazing and agriculture.

It is said that the Legislatures of the States of New York and New Jersey will be asked at their next sessions to provide for the building of a broad roadway 15 miles long at the base of the Palisades and to protect them from injury by quarrying.

We are glad to learn that on June 19th a Zoological Club was organized at Springfield with nineteen members. The first officers are: President, W. W. Colburn; Secretary, Miss M. A. Young; Treasurer, Miss L. I. Mattoon; and Dr. George Dimmock and Miss M. A. Booth, additional members of the Executive Committee.

The Park Board of New York City has adopted the plans for the buildings of the new Botanical Gardens in Bronx Park, as modified by the directors in accordance with the advice of a committee consisting of Professor Sargent and Messrs. Olmsted, Hastings and Parsons.

The library of Columbia University has received from an anonymous donor 387 books, valued at $6,000. These include a number of valuable works in natural history, such as Audubon's Quadrupeds, Sepp's Nederland'sche Insekten, Gould's Humming Birds and Levaillant's Oiseaux d'Afrique.

It is stated in *Die Natur* that Dr. O. Zacharias reported at a recent meeting of the Saxon Fisheries Association that the Prussian government would, after October of next year, give assistance to the biological station at Plön.

The Boston *Transcript* states that an expedition under the charge of Mr. C. M. Harris, of Angusta, Me., has sailed from San Francisco for the Galapagos Islands, with a view to studying their fauna and flora. It is said that Messrs. E. D. Hall, of Dartmouth; F. P. Duowle, of Providence, and R. I. Beck and R. H. Beck, of California, are members of the expedition, and that the expenses are defrayed by Mr. Walter Rothschild.

The Australasian Association for the Advancement of Science will, as we have already announced, hold its seventh session at Sydney, commencing January 6, 1898. Professor A. Liversidge is the President-elect. The President and officers of the several sections are as follows:

Section A—Astronomy, Mathematics and Physics. President, R. L. J. Ellery, C.M.G., F.R.S.; Secre-

taries, Professor A. Threlfall, M.A., J. Arthur Pollock, B.Sc.

Section B—Chemistry. President, T. C. Cloud, A. R.S.M., F.I.C., F.C.S.; Secretary, W. M. Hamlet, F. I.C., F.C.

Section C—Geology and Mineralogy. President, Captain F. W. Hutton, F.R.S., F.G.S.; Secretaries, Professor T. W. E. David, B.A., F.G.S., E. F. Pittman, A.R.S.M., F.G.S.

Section D—Biology. President, Professor T. J. Parker, D.Sc., F.R.S.; Secretaries, Professor W. A. Haswell, M.A., D.Sc., F.L.S., J. H. Maiden, F.C. S., F.L.S.

Section E—Geography. President, to be appointed. Secretary, H. S. W. Crummer, Secretary Royal Geographical Society of Australasia.

Section F—Ethnology and Anthropology. President, A. W. Howitt, F.G.S.; Secretary, John Fraser, B.A., LL.D.

Section G—Economic Science and Agriculture. President, R. M. Johnson, F.L.S.; Secretaries, R. R. Garran, B.A., F. B. Guthrie, F.C.S.

Section H—Engineering and Architecture. President, H. C. Stanley, M.I.C.E.; Secretaries, J. W. Grimshaw, M.I.C.E., M.I.M.E., H. C. Kent, M. A.

Section I—Sanitary Science and Hygiene. President, Hon. Allan Campbell, M.L.C., L.R.C.P.; Secretary, Dr. F. Tidswell, M.B.

Section J—Mental Science and Education. President, John Shirley, B.Sc.; Secretary, Professor Francis Anderson, M.A.

THE business meeting of the British Medical Association will be held in London on July 27th, to discuss the reports of the Council and of the various committees, and will then adjourn for the meeting at Montreal, beginning on August 31st. The meeting at Montreal, the first to be held outside the United Kingdom, promises to be very successful. The Dominion government has voted a sum of £1,000 to the reception fund, the government of the Province of Quebec £500, and other public bodies have been equally generous. The *British Medical Journal* has published an extended list of those who have signified their intention to be present, including the names of many eminent British physicians and men of science.

THE current number of *Nature* contains the first of a series of articles by the editor, Professor Norman J. Lockyer, on the approaching total eclipse of the sun. It appears that the weather prospects of the eclipse to be observed in India, on January 22d of next year, are extremely favorable. The meteorological reporter to the government of India states that the chances of any given day in January being rainy in Konkan is less than one in one hundred and fifty. The Joint Committee of the Royal and Royal Astronomical Societies have determined to send out three parties to observe, one on the coast and two inland, at stations to be subsequently decided upon. It has been arranged that the party from the Solar Physics Observatory will occupy the coast station if the Admiralty can grant the use of a man-of-war to allow an attempt to be made to repeat the *Volage* programme of 1896. In this case the station will possibly be the old fort at Viziadurg. The land parties, which will include the Astronomer Royal, Professor Turner and Mr. Newall, representing the Observatories of Greenwich, Oxford and Cambridge, together with Dr. Common and Captain Hills, occupy stations near the central line on the railways shown on the map (Fig. 1).

IT is reported in the daily papers that Dr. David Starr Jordan stated before leaving for Alaska that, as the British government has not come to satisfactory terms with the United States for the protection of fur seals in Bering Sea, the United States will begin this summer, through the Fur Seal Commission, the work of branding the female seals in the Pribilof Islands. This will spoil the skins of branded seals and stop pelagic sealing by making it unprofitable. One of Dr. Jordan's assistants, Elmer Farmer, expert electrician, has invented an electrical machine for branding seals, and if it prove satisfactory it will do a great deal toward settling the seal question. There is a possibility that the female seals may be coralled on one of the islands during the sealing season.

AN International Congress of Technical Education took place in London on June 15th, 16th, 17th and 18th. M. Saignat, the retiring President, made some remarks in introducing the President, the Duke of Devonshire, who addressed the Congress at length. Papers were presented by Professor Otto N. Witt, of the Berlin Polytechnic Institute; Dr. H. E. Arm-

strong, Sir Henry Roscoe, Professor G. Lunge of Zurich, Mr. G. R. Redgrave and others. The United States appears not to have been represented by delegates.

A DECREE has been signed by the President of the French Republic regarding medical experts before the Courts of Algeria. It appears that such experts must be appointed at the beginning of each year, and receive a fixed compensation for such services as are rendered.

UNIVERSITY AND EDUCATIONAL NEWS.

THE will of the late Dr. George Edwards leaves $50,000 to Princeton University for the endowment of a chair in American History and $2,500 for other purposes.

AT the commencement exercises at Beloit College, Dr. G. K. Pearsons presented the College with $30,000 to build a woman's hall. Dr. Pearson's previous gifts to the College amount to $250,000.

PRESIDENT SEELEY announced at the commencement exercises of Smith College that $10,000 had been offered to the College for the erection of a building for the scientific laboratories on condition that $9,000 should be subscribed by the alumnæ.

UPON the recommendation of the Faculty of the College of Physicians and Surgeons, Columbia University, the title of the chair of chemistry and medical jurisprudence was changed to that of physiological chemistry. The chair has not yet been filled.

DR. THOMAS S. FISKE, adjunct professor in mathematics in Columbia University, has been promoted to a full professorship.

PROFESSOR M. V. O'SHEA, of the Buffalo School of Pedagogy, has been appointed to the chair of pedagogy in the University of Wisconsin.

THE trustees of Oberlin College have elected as President, Dr. William Slocum, now President of Colorado College.

DR. FUCHS has been promoted to an associate professorship of paleontology in the University at Munich. Dr. G. Boccardi has been appointed associate professor of microscopical anatomy at the University of Naples, and Dr. J. Szadowski associate professor of geology at the University at Klausenburg. Dr. E. Wiechert has qualified as docent in physics at the University at Göttingen, Dr. Adolf Marcuse as docent in astronomy in the University of Berlin, and Dr. Max Dettrich as docent in chemistry in the University at Heidelberg.

DISCUSSION AND CORRESPONDENCE.

PALEONTOLOGICAL AND EMBRYOLOGICAL METHODS.—A REJOINDER.

ALTHOUGH I would have preferred to postpone the discussions on the systematic position of Tarsius which was commenced a few months ago (SCIENCE, February 12th, April 2d, April 23d) till the publication of a more extensive memoir which is at present in preparation, I may yet be allowed to say a few words in reply to Mr. Earle's "claim that the paleontological method in determining phylogeny is more nearly accurate than the embryological, as in the latter many characters are lost and innumerable cænogenetic variations are introduced which the embryologists often cannot distinguish from real homogenetic structures."

Leaving aside the somewhat loose constructions as to a 'method' in which 'characters are lost and 'variations introduced,' and considering it to be the writer's intention to point out to us that the facts which are brought to light by embryological research are for many reasons less reliable than those which we owe to paleontological science, I would wish the readers of SCIENCE to follow up that line of reasoning a little more closely. For it would seem to me that if we run a great risk of going astray in comparing the characters of the early embryos with each other because these characters are influenced by 'cænogenetic variations,' it is *a fortiori* none the less dangerous to compare the adult structures which develop out of these embryonic rudiments and upon which the same caution should necessarily be brought to bear. In that respect a paleontologist can hardly be said to be in a safer corner than an embryologist.

When, however, the embryologist wishes to construct phylogenetic trees out of his ontogenetical data I quite agree with Mr. Earle

that he is on less stable ground than the paleontologist who, for example, in the case of the horse has dug up the actual tree out of the successive Tertiary strata. Ontogenetic development undoubtedly makes us acquainted with cænogenetic variations which have been the cause of many a premature conclusion. In Tarsius, however, it was not to any changes, hypothetical or otherwise, that attention was directed by me, but on the contrary to a *persistence* of a most unexpected *agreement* which reveals itself in the numerous details of a complicated arrangement, such as is only found in man, the monkeys (as far as investigated) and Tarsius. And whoever calls attention, as Mr. Earle does, to the liability of embryological structures to vary must necessarily recognize the high value of those cases in which there is evidence not of variation, but of stability. It is because of this stability that Tarsius should be placed somewhere between (though not, of course, in the direct line) the Anthropoids and their unknown Mesozoic ancestors with a non-diffuse placentation.

Mr. Earle's assumption that the diffuse stage of placentation of some of the Anthropoids is apparently directly comparable to that of the Lemurs is invalidated by recent researches on early human plastocysts, researches which all tend to confirm the objections against such comparison which were raised by me in 1889 (*Quar. Journ. of Micr. Science*, Vol. 30, p. 364 and p. 382).

Finally, Mr. Earle's contention "that it has not been shown as yet that the placenta in the lemurs is not a derivative of the chorion, as in the apes," although perfectly justified when it was written, is nevertheless unsupported by the actual facts.

Since Milne-Edwards has emitted the opinion which Mr. Earle cites in a footnote, the Lemurine placentation has been again described in the *Quart. Journ. of Micr. Science*, Vol. 36, p. 90, pl. 9–12. In addition to that I may now state, on the strength of observations as yet unpublished, that in a true Lemur, such as Nycticebus, the fusion of the vascular walls of the allantois with the non-vascular diplotrophoblast can be followed step by step. It is a totally different process from that by which the vascular chorion of man, monkey and Tarsius comes into existence.

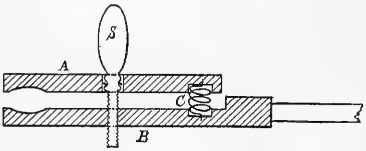
Another important point of difference between Lemurs and Tarsius which I have only lately been able to establish, thanks to the preparations just alluded to, is the presence in Nycticebus of a typical proamnion, so common among the lower Placental Mammalia and wholly absent in Tarsius and in man.

A. A. W. HUBRECHT.

UTRECHT, May 18, 1897.

A CLAMP FOR FRAGILE GLASSWARE.

WE have for some time been using a simple modification of the well-known wood clamp, which has given sufficient satisfaction to warrant a brief description. The clamp is constructed for holding light tubular glassware like Crookes' tubes, and it acts at once as a screw clamp and a spring clamp. The jaws, *A*, *B*, are set at any desirable distance apart by the screw, *S*. Loose pins allow *A* to rock slightly in the plane of the screw. The spring, *C*, in the rear presses strongly outward. When set, the jaws may thus be further opened (like a spring clip) by compressing the spring, *C*, with the hand. The jaws may be either flat or notched and need no packing.



This clamp has the following advantages: By aid of the screw the clamp may be adjusted to fit any tube up to over 2 inches for the ordinary size of clamp. The tube is removed or again inserted by mere pressure of the hand in the rear end of the jaws, *A*, *B*; the gradual counter-pressure of the spring prevents crushing of fragile apparatus, even when no cork or rubber cushion is used, while it can be intensified to hold very heavy objects.*

CARL BARUS.

BROWN UNIVERSITY, PROVIDENCE.

* The clamp can be obtained from Eimer & Amend, in New York.

MERRILL'S 'TREATISE ON ROCKS.'

TO THE EDITOR OF SCIENCE: In animadverting on the defective English of Professor Merrill's 'Treatise on Rocks,' etc., in your current number, Mr. Woodworth says: "In the case of other quotations it is sometimes doubtful as to which author the work in a certain district is to be referred" (page 996). Will the author of this sentence kindly express his idea in German or French or Chinook, and thereby oblige half a dozen readers who find themselves unable to grasp his exact meaning?

W J MCGEE.

WASHINGTON, D. C., June 26, 1897.

THE TRIAL OF THE CROSSLEY REFLECTOR OF THE LICK OBSERVATORY.

A MATTER relating to work at the Lick Observatory (with reference to the trial of the three-foot reflecting telescope presented to us by Mr. Crossley, of England, in 1895) has lately been discussed in newspaper press-dispatches in rather a one-sided fashion. I desire to say that the questions involved have been passed upon by the Regents of the University of California, who have, unanimously, approved my action. The decisions of the Regents have not been spoken of in press-dispatches, which is my reason for writing this note.

EDWARD S. HOLDEN.

THE LICK OBSERVATORY, June 21, 1897.

SCIENTIFIC LITERATURE.

Our Native Birds of Song and Beauty. By HENRY NEHRLING. Published by George Brumder, Milwaukee. Vol. II., 4°. Pp. 453; 18 colored plates. Complete work in 16 parts, $16; bound in 2 vols., library binding, $18; handsome dark leather binding, $22.

The second complete volume of this admirable work, some of the separate parts of which have been already noticed in these pages, has now been issued to subscribers. The two volumes make a handsome addition to any library and should be in the possession of all lovers of birds. The work contains no technical matter, and little effort has been made to incorporate the latest facts bearing on the geographic distribution of the various species, the aim being to supply trustworthy accounts of the life histories of the birds in relation to their environment and in their relations to man. Mr. Nehrling has the instincts and sympathies of a naturalist. He is evidently a botanist and musician as well as an ornithologist, and his descriptions of bird life are generally woven in with pictures of shady ravines and forest glades or flowery dells where the birds and plants and landscape are seen together as they are in nature. His residence in widely separated localities—Wisconsin, Missouri, Texas and Florida—has enabled him to become familiar with a large proportion of the birds he treats, and his personal knowlege is supplemented by copious extracts from the writings of others. Special emphasis is given to economic relations and breeding habits.

As stated in notices of the earlier parts, the illustrations, all of which are colored, show the birds in natural surroundings and are of two kinds: plates of single species, mostly by Robert Ridgway; and mixed plates, by Mützel and Göring. Some of Mr. Ridgway's plates of single species are among the most charming bird pictures I have ever seen. Those of special excellence in the present volume are the Black Rosy Finch (*Leucosticte atrata*) and Dickcissel (*Spiza americana*)—the former on a mountain top, the latter in a clover field. Three of the mixed plates by Mützel are worthy of special mention; Plate XXI, a group of showy winter birds—the Pine Bullfinch, White-winged Crossbill, Redpoll, Evening Grosbeak, Nuthatch and Chickadee—in the top of a snow-covered spruce; Plate XXVIII, the Blue Grosbeak and three species of *Passerina*—the Indigo Bird, Painted Bunting and Lazuli Finch; Plate XXXVI, six species of brilliantly colored Woodpeckers.

Even in the mixed plates the attempt has been made to group the species in appropriate surroundings, and much pains has been taken with the landscape and vegetation. Thus, Göring's picture of the Scissor-tailed Flycatcher, Green Jay and Verdin shows these birds (and one or two others) among cactuses, flowering agaves, and aborescent yuccas with a barren range of desert mountains in the background.

Although the plates are of uneven merit, even the poorest are sufficiently good to serve the purpose of identification and will be most

helpful to the student. We take pleasure in commending the work to nature lovers, and particularly to the large and healthful class of of out-door students of birds.

C. H. M.

The Present Evolution of Man. By. G. ARCHDALL REID. London, Chapman and Hall. 1896. pp. 370.

The work which has appeared with the above title consists in fact of two parts; up to p. 196 it has reference to organic evolution in general, and only the remaining portion, pp. 197–370, treats especially of the evolution of man. In the earlier part of the work there is given a very excellent discussion of the broad principles of evolution, and particularly of the reasons which lead to the conclusion that acquired characters are not inherited by other than the lowest organisms. The argument against the transmission of acquired characters, as ordinarily understood, appears to the writer conclusive, and he would commend it to the neo-Lamarckians for dissection. It is also well shown that under ordinary circumstances natural selection works upon normal variations, and not upon those which occur only at infrequent intervals. Much stress is also laid, very justly, upon the importance of characters which are normally acquired, and of the power of acquiring them.

An interesting argument runs as follows: Inasmuch as progressive or new variations may be in all directions, but atavistic variations are in one direction—towards the ancestry—there will be a tendency, in the long run, *in the absence of selection*, to revert to a more primitive condition, owing to the dominance of the atavistic variations. When the evolution has been very slow, as with certain Brachiopoda, the reversion will be scarcely noticeable, but when it has been very rapid, as with many domesticated animals, the reversion will be rapid and striking. All this appears to accord with the known facts, but to the present writer it seems an inadequate statement of the actual course of events. Mr. Reid says: "In every species natural selection as a cause of evolution, and atavism as a cause of retrogression, are constantly at war." It does not seem to me that this is necessarily the case, but that, on the other hand, atavistic variations may be themselves selected. The germ, it must be supposed, contains units representing many phases of existence, some of which have been held over, undeveloped, through many generations, while others are new. When one of the latter develops we say the variation is a progressive one; when the former develop we call the result atavism. It is reasonable to suppose that environmental and germinal selection are the factors which determine which of its possible developments the germ shall undergo. That is to say, there are two factors involved, one the relative vitality or growth-force of the several germinal elements, the other the environment favoring one or the other in their struggle This same struggle, in various phases, goes on through life; for example, many people have two or more talents, which cannot be fully exercised simultaneously; other things being equal, the strongest will prevail, but how often the environment steps in and dictates which of the possible paths of life shall be followed.

This being made clear, it is evident that atavism increases the range of possibilities of any given germ, and thus may be highly advantageous. Especially is this the case when the environment is changeable, as with seasonally dimorphic butterflies, one phase of which is probably in most cases older than the other. My own studies of bees have led me to believe that many of the specific characters had their origin in atavistic variations, because it often happens that a character will appear in two different groups independently, and yet be so striking and definite as to suggest that it must have existed in a common ancestor, though not in the immediate ones.

How, then, as to atavism in the absence of selection? It is perfectly obvious that any given adult individual does not, under existing circumstances, represent the average potential, if one may so express it, of its race. In the first place, the individual is probably a survivor out of many—has been the subject of natural selection. In the second, it represents only one (selected) phase of the many that were possible to the germ. In the total absence of selection (an impossible thing) we should obviously

get the actual mean, or a series of individuals symmetrically arranged around that mean. This would involve more or less atavism, because the potentialties of the germs are derived from past generations, and include many repetitions, more or less complete, of phases which have lately, owing to the incidence of selection, been permitted no development. But I cannot see, with Mr. Reid, that there would be unlimited atavism, because when the atavistic changes had proceeded from B to A, the B-features would become ancestral, and a new atavism, from A to B, would appear. Thus at some point there would be reached a condition of equilibrium, and the tendency to vary in any particular direction would be lost. Existing species may be compared to elastic bodies under stress, the stress being natural selection. When the stress ceases, there is contraction until the condition of equilibrium is reached, but certainly not indefinite contraction.

The second portion of the book consists of a discussion of human evolution against zymotic diseases and narcotics. Mr. Reid argues that the way to tell in what direction the evolution of a species is tending is to observe the causes of mortality. Applying this test to man, he concludes that as disease is the principal cause of death it must be against disease that we are evolving. He then proceeds to show that those races which have long been subjected to a particular disease, *e. g.*, malaria or consumption, have acquired a relative immunity from it, or at least a power of enduring its attacks. The whole matter is set forth very clearly and is well worth reading. While it cannot be denied that the factor of zymotic disease is an extremely important one, hitherto generally overlooked in discussions on human evolution, I must say that I think Mr. Reid himself has overlooked some not less important factors. The 'social efficiency' of a people, as Mr. B. Kidd rightly insisted, is a factor of immense importance. Thus, in this very matter of zymotic diseases, how greatly is the death rate in an epidemic (and the existence of the epidemic itself) influenced by the social condition of the people, and even by their intellectual and moral condition, as reflected in the municipal government and sanitary arrangements! Thus, while, as Mr. Reid shows, the negro is under identical conditions far less affected by malaria than white people, Dr. J. S. Billings has to report, in summing up the statistics for 28 cities of the United States, that the deaths from malarial fever were more than three times as numerons, in proportion to the population, among the colored people as among the whites. It is fair to state that under the term 'colored' he includes the Chinese, etc., but the difference is conspicuous in those cities which are known to contain a large negro population. Mr. Reid may reply that sanitary arrangements and forms of government, affecting all, select nobody; but certainly they do select the citizens of one town, State or country as against others, or those of the rural districts as against the towns. Thus the population of large cities, like London, is perpetually replenished from the rural districts. A pure-bred cockney of the fourth generation is said by J. M. Fothergill to be very rare. Further, as Dr. Billings has shown (11th Census of the United States) the death-rate in every large city varies enormously in the different wards, and this must be due mainly to the mode of life of the people, their food, sanitation, and other matters directly connected with social efficiency. Still again, there is a tremendous proportion of infant mortality, a large part of which must be due to unfavorable conditions of the mother or child. Thus it must necessarily be that, while there are inequalities in morality and intelligence, the most moral and the most intelligent races or groups of people will be favorably selected in the struggle for existence.

The whole subject is one of immense complexity, and in studying the statistics one has to be constantly on the lookout for sources of error, which are numerous and confusing. But there is no doubt that Mr. Reid's discussion is a valuable one, if only it draws attention to matters which have been too much overlooked.

The final portion of the book, treating of evolution, against alcohol and other narcotics, seems to me to contain a fundamental error. It is assumed that a desire for alcohol is inherent in the human race, and that, since the substance cannot be banished, our only salvation is to gradually acquire a toleration of it, as of a

zymotic disease. It is shown that certain races are on the way to acquire such toleration, and in the presence of alcohol suffer much less than others. An obvious difficulty here is to explain how, under the influence of natural selection, this highly pernicious craving for alcohol arose. Mr. Reid says: "It can have arisen only as a bye-product of mental evolution, a bye-product which, in the absence of narcotics, was harmless, but which in the presence of them is harmful." This surely is a very far-fetched supposition, since it is implied that the craving for alcohol developed in the absence of that substance! To the present writer it appears evident that the human race has no natural craving for alcohol at all, but it has a craving for excitement and other states of mind which may be induced artificially, and that when the natural exercise of highly valuable faculties is denied, as is so often the case in our present civilization, artificial means, often highly injurious, will be resorted to. It will apparently sometimes happen that when an artificial stimulus is persisted in for a long while, and is not in itself injurious, it will become a necessity, just as clothes have become necessary to a large portion of mankind. As an instance of this, we may cite the use of hot flavoring substances (as pepper) by inhabitants of warm countries to promote digestion. It is conceivable also that a race might acquire considerable toleration of alcohol, and at the same time lose the power of acting efficiently except under its influence, so that a member of the race, separated from his bottle, would be powerless! But it is perhaps more likely that the process would be just that which Mr. Reid describes as inevitable, namely, that the desire for alcoholic stimulation would be lost, while at the same time the effects of drinking a given quantity of alcohol would become less. This is regarded by Mr. Reid as very desirable, but what if it means the destruction of a valuable faculty, which, rightly exercised, might have been once more, as originally, of great importance to the race? Put it in this way: The wretched laborer of a crowded city, overworked and underfed, desires to escape from his environment—desires, if only for a brief period, to be free. Alcohol gives him a temporary means of escape, but at a frightful cost. It is deplorable that he should seek it, but how much more deplorable it would be if he should cease to care—if he should become degraded to a mere machine, accepting without thought the suppression of three-fourths of his natural activities? Surely the remedy is not, as Mr. Reid supposes, to eliminate those who wish to drink, but to find the means of living full and active lives, in the natural exercise of all our functions.

T. D. A. COCKERELL.

MESILLA, N. M., June 8, 1897.

SOCIETIES AND ACADEMIES.

MEETING OF THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE New York Section of the American Chemical Society held its June meeting on the 11th inst., preceded by a dinner, at which thirty members participated, including the President of the General Society, Dr. C. B. Dudley. The meeting was called to order in the chemical lecture room of the College of the City of New York, at 8:30, by the chairman, Dr. William McMurtrie, who then invited Dr. Dudley to preside.

The death of Professor C. R. Fresenius at Wiesbaden was announced, and the Secretary was authorized to cable the regrets and condolence of the Society to his sons. An obituary notice of Dr. Carl H. Schultz was read by Dr. A. P. Hallock, after which the papers of the evening were read as follows:

F. S. Hyde, 'Comparative Tests for Identification of Some Medicinal Carbon Compounds.' E. G. Love, 'Note on Analysis of Cheese.' Benj. C. Greenbergh, 'Determination of Dextrine in Presence of Sugars.' Gustav Volckening, 'Novel Mechanical Arrangement of Fat Extraction Apparatus.' L. Reuter, 'Demonstration of Some Chloroform Compounds and of Some of Baumann's Thioaldehydes.' W. E. Chamberlin, 'Calibration of Volumetric Apparatus.' C. A. Doremus, 'Method of Collecting and Analyzing Gases contained in Canned Goods.'

It was stated by the chair that forty papers had been presented before the Section during the winter, a number considerably in excess of

any previous session, and the attendance at the meetings had averaged about fifty, also an increase over previous records. The Section was then adjourned until October.

Durand Woodman,
Secretary.

TORREY BOTANICAL CLUB, MAY 11.

Dr. N. L. Britton presided in absence of the President. Three new members were elected. Three successful field-meetings were reported. Resolutions were adopted commemorative of Dr. Emily L. Gregory, the late honored professor of botany at Barnard College, an active worker in the Club. Announcement was made of the recent gift, by President Low to the botanical department of Columbia, of a valuable set of water-color plates prepared by the late lamented Wm. Hamilton Gibson, in illustration of his projected work on mushrooms.

The paper of the evening followed, by Mr. Marshall A. Howe, entitled 'A Preliminary Comparison of the Hepatic Flora of California with that of Europe and of the eastern United States.''

The total number of Californian species now known is 77, of which 45 occur in the Mediterranean region, but only 37 in the Gray-Manual region of the United States.

It was shown that the hepatic flora of California has more in common with that of northern and central Europe than with that of the eastern United States, and is still more allied to that of the Mediterranean region. In particular, species of *Asterella* and *Riccia* are better developed in California and southern Europe than in the eastern United States.

The apparent absence in California of *Bazzania* and *Mylïa*, which are especially characteristic of medial and boreal regions, serves to heighten the similarity to southern Europe.

The paper was followed by exhibit of photomicrographs of sections of Cryptomitrium, illustrating the development of the archegonia. In the discussion following, Professor Underwood said that the Hepatic species are most numerous in the Amazon region, the eastern slope of the Andes, and in Java. Insular tropical regions have furnished many where examined, as Cuba and Jamaica. Quite a number are peculiar to Australia. New Zealand is well supplied with species. Many have been recently collected in Africa, and have been described by Herr Stephani, of Leipsic, whose industry has doubled the number of described Hepaticæ. As a whole, the maximum development of the Hepaticæ is tropical, though some genera and certain groups within genera are wholly high-temperate or subarctic.

Professor Britton, remarking the indications of circumboreal and circumtropical distribution of certain species, referred to the argument for an equatorial distribution of flowering plants and of ferns, and queried if there were anything corresponding among Hepaticæ. He expressed the belief that it is the immediate environment which at present exerts the principal influence on distribution, whatever the original cause or mode of distribution may have been.

Professor Underwood referred to the influence of the Gulf Stream in permitting the existence of the subtropical genus *Lejeunia* on the coast of Ireland, a genus not elsewhere found in Europe. Comparing the Hepaticæ of Florida, they are only in part known; a few species are in common with the Appalachian flora; most of the Florida Hepaticæ are close-creeping forms found on bark, as *Frullania* and *Lejeunia*, having water-sacs on their leaves as aids in resisting drought. Some tropical *Marchantiaceæ* occur in Florida, and also, especially, species of *Riccia* and *Anthoceros*. *Thallocarpus* is known only from Florida and South Carolina.

Edward S. Burgess,
Secretary.

NEW BOOKS.

Formation de la Nation Française. Gabriel de Mortillet. Paris, Alcan. 1897. Pp. iv + 336. 6 Fr.

Introduction to the Study of Economics. Charles Jesse Bullock. New York, Chicago and Philadelphia, Silver, Burdett & Co. 1897. Pp. 511. $1.28.

Grundprobleme der Naturwissenschaft. Adolf Wagner. Berlin, Gebrüder Borntraeger. 1897. Pp. vi + 255.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, JULY 9, 1897.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*THE PHYSIOLOGY OF INTERNAL SECRETIONS.**

WE owe the term 'internal secretions' to Brown-Séquard,† by whom it was first used in published communications dating from 1891. The essential idea conveyed by the expression, however, is not new, as it has been stated more or less clearly by many previous writers in their speculations upon the probable functions of the so-called ductless or vascular glands. It had long been recognized that these glands possess no excretory ducts, and that, therefore, whatever secretion they may produce probably enters the blood either directly or by way of the lymph. Haller* is credited with stating this view with regard to the thyroid as early as 1776, and according to Pettit† a similar view was advanced by Schmidt in 1785 with regard to the suprarenals. Toward the middle of the present century this belief was generally accepted for such glands as the thyroid, suprarenals, thymus, hypophysis cerebri and spleen, but as early as 1869 Brown-Séquard seems to have suggested the view that all glands, whether possessed of excretory ducts or not, give off something to the blood that is of importance in the general nutrition of the organism. From 1889 his ideas took definite shape in numerous publications‡ upon the physiological effects of injections of extracts of the testis. At first he did not use the term internal secre-

*Paper read at the 4th Triennial Session of the Congress of American Physicians and Surgeons.

† Brown-Séquard and d'Arsonval: Comptes rendus de la Société de Biologie, 1891.

* Jones in Todd's Cyclopædia of Anatomy and Physiology: Article on Thyroid Gland.

† Pettit: Recherches sur les capsules surrénales, 1896—Paris. Thèse de la Faculté des Sciences.

‡ Brown-Séquard: Archives de Physiologie normale et pathologique 1889–92.

tion, and seems to have held the view, so far as the testis is concerned, that the material furnished to the blood is absorbed from the external secretion and is normally carried off in part in this secretion.

During this same period the brilliant results of the experiments made upon the thyroid glands and the pancreas were forcing themselves upon the attention of physiologists, and these results, together with his own experiments upon the extracts of testis and ovary, and his previously expressed belief as to the possible effect exercised by all glands upon the composition of the blood, seem to have led Brown-Séquard to the generalization expressed in the happy term 'internal secretion.' The term as used by him was not restricted to the glandular tissues alone, but was meant to signify that all the tissues in the body furnish something of special importance to the blood—that, in fact, every act of nutrition is accompanied by an internal secretion This broadening of the term to apply to all the tissues is logical, perhaps, but it must be admitted, I think, that so far as our actual knowledge goes it is not justifiable. The evidence derived from experimental investigations and clinical observations indicate that many, although not all, of the glandular tissues of the body as a result of their normal metabolism add something to the blood or affect its composition in some way, and that this activity is either essential or helpful to the maintenance of the normal functions of the organism. In this list we can place such glands as the liver, pancreas, thyroid and parathyroid bodies, suprarenal bodies, hypophysis cerebri, and probably the ovary, testis, thymus and spleen. But I know of no observations that force us to entertain a similar belief with regard to the non-glandular tissues, such as muscle, nerve and connective tissue.

So far as I am aware, there is no authorized definition of the term internal secretion, but, if we adhere closely to the facts in the case, the expression may be interpreted to mean certain products that are elaborated by gland cells from material furnished by the blood, which are afterwards passed back to the blood or lymph stream to subserve some function in general or special nutrition. From the standpoint of mechanism of secretion a useful distinction has been drawn between these internal secretions and secretions of the usual kind, or external secretions. The latter are in all typical cases poured out upon a free epithelial surface that communicates with the exterior, while the internal secretions are discharged upon the close endothelial surfaces of the blood and lymph vessels.

The definition given by Brown-Séquard, as we have seen, attributed internal secretions to all tissues. As a part of this general conception he was led also to restate what appears to have been a dream of the older physicians, namely, the view that all animal tissues might and ought to be employed in special cases as means of medical treatment, extracts of each organ or tissue being recommended for the particular disease supposed to be due to disturbance of function in the corresponding tissue. This general conclusion seems to have been a wide induction upon the basis of the incomplete facts known at that time with regard to the therapeutical use of extracts of thyroid and testis. It was not entirely justified by actual experience then or now, but the attractive possibilities it presents have doubtless been the cause of much of the general interest manifested in the subject of internal secretions. A new field, hitherto almost unexplored and full of promise for the discovery of medical specifics, seemed to be opened to the medical profession, and much activity has been exhibited in exploiting the possibilities of this kind of therapeutical treatment for

which the names *opotherapeutics*, *organotherapeutics* and *histotherapeutics* have already been suggested.

It must be borne in mind, however, that these promises are in large part premature. The one clearly successful method of treatment by animal tissues is the use of thyroid extracts, and the demonstration of the value of this method was the result of rigorous scientific work extending over more than a decade, and was obtained quite independently of the generalization announced by Brown-Séquard. It seems perfectly certain that whatever else of value may come out of the therapeutical application of tissue extracts must also be established by intelligent scientific research, on the side of experimental as well as clinical medicine, and not by indiscriminate and over-anxious attempts to secure immediate results.

It is my purpose to-day to call your attention briefly to some of the important results obtained by experimental physiology that tend to prove the existence of internal secretions in a number of glandular organs. The main interest to the physiologist lies, perhaps, in the light this work has thrown upon the functions of the blood-glands, or ductless glands, especially the thyroid, suprarenals, hypophysis cerebri, thymus and spleen. Forty years ago the physiology of these bodies was not only unknown, but was beyond the reach of intelligent hypotheses. Within recent years facts have accumulated, especially with regard to the thyroid and suprarenals, that give us a new standpoint from which to view their physiology—a standpoint also from which experimental investigations may be planned with reasonable hope of abundant success in the future. I shall not attempt an historical review of recent work in this subject, as this has been given already in numerous general addresses and special papers.* I desire only to emphasize what seems to be the outcome of the physiological work that has been done in the last twelve or thirteen years, and to explain briefly the character of the work now in progress.

If we include under the term 'thyroid tissue' not only the thyroid body itself, but also the accessory thyroids and the neighboring parathyroids, it has been shown beyond reasonable doubt that complete removal of this tissue in man and the related mammals is followed, as a rule, by serious disturbances of nutrition that are immediately or ultimately fatal to the animal. Moreover, in these cases the reintroduction of thyroid material into the body, whether this introduction be made by grafting the tissue, by subcutaneous or intravascular injections or by absorption from the alimentary canal, results in an amelioration or even entire removal of the symptoms of malnutrition. The physiologists recall with pleasure that these two fundamental facts were first discovered as the result of experimental work in physiology. The effects of complete thyroidectomy were first described by Schiff* in 1856, and the therapeutical use of thyroid tissue arose naturally from the grafting experiments of Schiff† in 1884 and the subsequent experiments of Vassale ‡ and of Gley § upon injections of thyroid extracts. The brilliant results that have followed the use of thyroid tissue in man in cases of myxoedœma, goitre, etc., are, too well known now to require more than a passing reference.

*See especially Abelous: *Revue générale des Sciences*, May 15, 1893.

Schäfer: Address in Physiology; Annual Meeting of the British Med. Assoc., London, 1895.

Meltzer: On Thyroid Therapy; *New York Med. Jour.*, May 25, 1895.

*Schiff: Untersuchungen über die Zuckerbildung in der Leber, etc., Würzburg, 1859.

†Schiff: Revue médicale de la Suisse romande, 1884.

‡Vassale: Rivista sperimentale di freniatria, etc., Vol. XVI.; also Centralblatt f. d. Med. Wiss., 1891.

§Gley: Comptes rendus de la Soc. de Biol., 1891.

It follows as a logical conclusion from the successful effects attending its therapeutical use, as well as from the evil effects of its destruction or removal, that the thyroid tissue produces, normally, something that is in some way essential to the nutrition of the body. What that something is has been revealed partially by the beautiful chemical and clinical researches of Baumann and Roos. Baumann * has succeeded in isolating a substance, thyro-iodin, or iodothyrin, as it has been named more recently, which, according to the experiments of Roos,† preserves the beneficial effects of thyroid tissue.

The chemical characteristics of this compound will doubtless be presented in Professor Chittenden's paper. It has proved to be a very stable compound, unaffected by boiling, by strong acids and by gastric digestion, and this fact may be taken as a complete disproof of a former view to the effect that the action exerted upon the body by thyroid tissue is due to the presence of special enzymes or ferments. The fact that extracts of thyroid tissue or iodothyrin when absorbed into the blood ameliorate or remove the evil effects resulting from loss of function of the thyroid, seems to prove at once that the normal function of thyroid tissues is not merely to excrete poisonous material from the blood after the manner of the kidneys. It indicates, on the contrary, that these tissues act normally by giving off a material to the blood that in some way affects favorably the nutrition of all or a part of the tissues of the body. In other words, the thyroid tissues form a true internal secretion. Histological research indicates that, so far as the thyroid bodies proper are concerned, this secretion is contained in the so-called colloidal material that accumulates in the interior of the vesicles, and that the mechanism of secretion consists in a rupture of the walls of the vesicles at some point whereby the contents are discharged into the surrounding lymph spaces.*

The most important fact that remains to be discovered is the manner of action of this secretion upon the tissues of the body. At present we can only speculate upon the answer to this problem. More experimental work is required before a definite solution can be reached. To account for the action of the thyroid secretion two main hypotheses have been proposed. According to one hypothesis the function of the secretion is antitoxic. In some way it antagonizes an unknown toxic substance supposed to be formed in the body in the course of normal metabolism. When the thyroid tissues are removed this poisonous material, being imperfectly excreted, accumulates in the blood and produces the fatal symptoms of thyroidectomy by a process of auto-intoxication. The other hypothesis assumes that the secretion of the thyroid acts normally by promoting or regulating the metabolism of other parts of the body, particularly, perhaps, of the nervous tissues. We might designate this as the trophic or neuro-trophic hypothesis. It is less specific than the antitoxic hypothesis, and therefore, perhaps, less objectionable in the present incomplete state of our knowledge; but as no decisive, or even probable, proof can be given for either view, it seems unnecessary to criticise the various facts brought forward in support of one or the other of them. The two great facts to be explained are: first, that complete removal of the thyroid tissues brings on a condition of malnutrition that seems to affect especially the central nervous system; and, second, that injection or ingestion of thyroid ex-

* Baumann: Zeitschrift für physiolog. Chemie, Bd. XXI., 1896; also Bd. XXII.

† Roos: Ibid Bd. XXII.

*Biondi: Berliner klinische Wochenschrift, 1888. Langendorff: Archiv für Physiologie, 1889, Suppl. Bd. Schmid: Archiv für mik. Anatomie, 1896.

tracts while the animal is in this condition restores its metabolism more or less completely to the normal state. While both of these facts are explicable in terms of either of the hypotheses mentioned, the trophic theory does not involve the somewhat strained assumption of an unknown toxic product of metabolism that can not be got rid of completely by the usual methods of excretion.

A very interesting phase of thyroid physiology that has recently come to the front is the nature of the functional relationship between parathyroid tissue and thyroid tissue proper, such as is found in the thyroid body and the accessory thyroids. The parathyroids seem to occur in all mammalia. According to a recent description by Kohn* there is always one of these bodies on each side attached to the external or posterior surface of the lateral lobes of the thyroid, while in some animals, *e. g.*, the dog, cat and rabbit, there is an additional one on each side, imbedded in the substance of the thyroid lobes. Histologically the structure of these small bodies bears no resemblance to that of the thyroid. They possess the general appearance of embryological tissue, and have, therefore, been regarded usually as an immature form of thyroid tissue, which, under the stimulus of increased functional activity, is capable of developing into normal thyroid structure. Satisfactory evidence is lacking that such a transformation does actually take place under the conditions supposed, as, for example, after complete excision of the two thyroid lobes. On the contrary, the evidence from histology, as well as from embryology, seems to indicate that the two tissues are not only fundamentally different in structure, but possibly are also different in origin.

On the physiological side Gley † was the first to prove the great importance of the parathyroids. He showed that in rabbits complete extirpation of the thyroid lobes alone is not followed by a fatal result so long as the parathyroids remain. Removal of both thyroids and parathyroids, however, is in most cases followed by typical symptoms of complete thyroidectomy ending in the death of the animal. This latter result has been contested by some observers, but renewed investigations have demonstrated its accuracy. Gley explained his results on the hypothesis that after removal of the thyroid its function is vicariously assumed by the parathyroids. He concluded, therefore, that the functional value of the two tissues is identical. Recent work, however, tends to throw doubt upon this conclusion. Vassale and Generali * state that in dogs and cats removal of all four parathyroids produces the acute symptoms of complete thyroidectomy, and finally causes the death of the animal, in spite of the fact that the thyroid body proper is left practically uninjured. On the other hand, complete removal of the thyroid lobes is not immediately injurious to the animal, provided the parathyroids—or, in some cases, if even only one of the parathyroids—are left. They contend, therefore, that the result in dogs and cats usually attributed to extirpation of the thyroids is due in reality to the simultaneous removal of the parathyroids.

This result is partly confirmed by the independent experiments of Rouxeau † and of Gley. ‡ The former finds that in rabbits complete removal of the thyroids alone causes no trouble, at least no immediate trouble, while excision of the external parathyroids alone is followed frequently by death, or by convulsive symptoms. Gley

*Kohn: Archiv für mik. Anatomie, Bd. 44, 1894.

† Gley: Archives de Physiologie normale et pathologique, 1892.

* Vassale and Generali: Archives italiennes de Biologie, XXV. and XXVI., 1896.

† Rouxeau: Comptes rendus de la Soc. de Biologie, Jan. 9, 1897.

‡ Gley: Ibid.

reports some incomplete experiments upon rabbits and dogs that tend in the same direction. Finally, Moussu,* from experiments made upon mammals and birds, attempts to define in general terms the difference in function between thyroid and parathyroid tissue. According to his experiments, removal of the parathyroids alone is followed by certain acute troubles, such as have been usually described as the result of complete thyroidectomy, while removal of the thyroid lobes alone is followed by chronic troubles of nutrition which he designates as myxoedœmatous or atrophic cretinism. This last result has not been confirmed, so far as I am aware, by others, so that it cannot be accepted with entire confidence. It will be noted, however, that the tendency of this recent work is to show that the functional value of the thyroids and parathyroids is not identical, and that the importance hitherto attributed to the thyroids must be assigned, in part at least, to the parathyroids. The very great interest that these results may have when applied to human pathology and therapeutics will be evident to everyone.

Finally, a word may be said as to the possibility that other tissues exist in the body capable of replacing entirely or in part the functions normally performed by the thyroids or the parathyroids. This possibility seems to be indicated by the fact, commented on by most experimenters in in this field, that occasionally animals are found in which apparently complete removal of all the thyroid tissue, including the parathyroids, is not followed by a fatal result. Such cases may be explained by assuming the existence of accessory thyroids or parathyroids that escape the attention of the operator, but it is also possible that they may be due to the fact that there are other organs in the body that possess a thyroid function. Experiments in this direction have been made upon the spleen and the hypophysis cerebri. With regard to the former organ the results may be considered as entirely negative, while as regards the hypophysis the evidence is unsatisfactory. Some details concerning this last organ will be presented later.

* Moussu: Ibid, Jan. 16, 1897.

The results of recent physiological experiments upon the suprarenal bodies have not been less interesting, although less complete than those upon the thyroid. These curious bodies, like the thyroid, are found constantly in all classes of the vertebrates, and seem, therefore, to be organs of fundamental importance. As long ago as 1856 Brown-Séquard* stated that extirpation of both suprarenals is usually fatal to the animal, death occurring generally very shortly after the operation, more rapidly, according to this observer, than after removal of both kidneys. This statement has been questioned frequently by other observers, but the results of the renewed investigations that have followed upon the recent revival of interest in the physiology of the ductless glands seem to corroborate fully the account given by Brown-Séquard. In the case of dogs, according to Szymonowicz,† death follows the operation within fifteen hours. It has been shown, also, that in some species of animals accessory suprarenals are not uncommon, and it is possible that this fact may explain the survival of a certain number of animals after supposed complete extirpation of the suprarenals. Removal of only one suprarenal does not appear to cause any noticeable trouble. In the case of complete removal, followed by a fatal result, the prominent symptoms preceding death are extreme muscular weakness, asthenia, and, in the case of dogs examined

*Brown-Séquard: Comptes rendus de l'Ac. des Sciences, XLIII., 1856. *Journal de la Physiologie*, I., 1858.

†Szymonowicz: Archiv f. d. gesammte Physiologie, LXIV., 1896.

during this period, a great fall in blood pressure, together with a feeble heart-beat. It will be noted that in cases of Addison's disease in man the important symptoms, in addition to the pigmentation, are also an asthenic condition of the muscles and the heart. What explanation have we to offer for the surprisingly profound effect produced upon the body by the removal of these small organs?

Unquestionably, the most significant facts with regard to this problem have been obtained from a study of the effects of injections of suprarenal extracts into living animals. A number of the earlier experiments of this kind, especially those performed upon rabbits, resulted in the death of the animal, the preceding symptoms being convulsive movements, followed by some paralysis. The really valuable results, however, have been obtained by a more exact study of the effects of such injections upon the vascular and respiratory organs. Most of our knowledge upon these points has been derived from the researches of Oliver and Schäfer,* and Cybulski and Szymonowicz.† These two sets of investigators published their results nearly simultaneously. The important facts determined by them, and since corroborated in many laboratories, are as follows: Extracts of the medulla of the suprarenal bodies injected into the veins of a living animal cause a pronounced slowing of the heart-beat and a large rise of blood pressure. If the animal is first given atropin to paralyze the inhibitory nerves to the heart, or if the vagi are previously cut, the injection causes usually a marked quickening, instead of a slowing of the heart-beat, and a greater, indeed often an extraordinary, rise of blood pressure. The respiratory organs are not affected so seriously, a temporary slowing and shallowing of the respiratory movements being the result usually noticed. The effect upon the heart and blood vessels is quite temporary. Its exact duration depends somewhat upon the dose, and in part upon other less evident conditions, but, as a rule, within a very few minutes the rise in blood pressure, as well as the slowing of the heart-beat, passes off completely. New injections will bring out promptly a return of the effect described, although a continued repetition of the injections at too close intervals results in a progressive diminution of their action. Tying off the kidneys does not appear to prolong the effects of an injection, so that we may conclude that the temporary character of the result produced is not caused by a rapid elimination of the active substance through the kidneys, although, according to Szymonowicz, a part of it, at least, is got rid of by this means. The rapid disappearance, however, of the effects of a maximal or supramaximal dose indicates that the active substance is either quickly destroyed in the tissues or is neutralized in some unknown way.

The physiological explanation of the slowing of the heart caused by the suprarenal extracts offers no difficulties. Since this effect disappears completely upon section of the vagi, or after the injection of a few milligrams of atropin, it can only be due to a stimulating action upon the central endings of the inhibitory fibres, that is, upon the so-called cardio-inhibitory center in the medulla. According to Oliver and Schäfer the inhibitory effect is felt mainly upon the auricles. The beats of this part of the heart become weaker and slower and may cease altogether, while the ventricular beats, although slower, are more vigorous. After the vagi have been cut, suprarenal extracts cause a quicker and, according to Oliver and Schäfer, who measured the extent of

*Oliver and Schäfer: *Journal of Physiology*, XVIII., 1895.

† Cybulski and Szymonowicz: *Gazeta Lekarska*, 1895. (Abstracted in Jahresb. d. Thier-Chimie, 1895. Also Szymonowicz: Archiv. für d. gesammte Physiologie, LXIV., 1896.

the contractions directly, a stronger beat. This accelerating effect upon the heart after removal of the inhibitory fibres is not due, as we might at first suppose, to a stimulation of the central ends of the accelerator fibres, since it is still obtained after section of the cord in the neck, or after extirpation of the first thoracic ganglia. It must, therefore, be due to a peripheral action of the extracts upon the heart itself, either upon the muscle of the heart directly (Oliver and Schäfer) or upon the so-called motor ganglia (Szymonowicz, Gottlieb).

The effect of the injections upon blood pressure has been explained differently by those engaged in the work. Both Oliver and Schäfer, and Cybulski and Szymonowicz, believe that the enormous rise in blood pressure is due mainly to a great constriction of the arterioles. According to the latter this constriction is brought about by a stimulating action of the extracts upon the vaso-motor centers in the medulla and cord, while according to Oliver and Schäfer the action is exerted directly on the muscles of the blood vessels. Szymonowicz admits that if the cord is cut just below the medulla a great rise of pressure can still be obtained, but he explains this by supposing that the extract acts on the spinal centers. He asserts that if the entire cord is destroyed a rise of pressure can no longer be obtained. The experiment that he gives to illustrate this last point is, however, far from being convincing. The protocol of the experiment shows that the act of destroying the cord in itself reduced the blood pressure to zero. Moreover Biedl* reports that he has been able to get a rise in pressure from injection of the extracts after complete extirpation of the cord. The evidence, therefore, seems to favor the view proposed by Oliver and Schäfer, and this view is still further supported by the fact that when the volume of a limb is measured plethysmographically it often shows a distinct diminution after suprarenal injection, even though its nervous connections with the central nervous system are entirely severed.

*Biedl: Wien. klin. Wochenschrift, IX., 1896.

There are, however, some facts reported in the experiments made by different observers which indicate that the assumed action of the substance on the peripheral arteries does not alone account for all the changes produced in blood pressure. It is probable that the greater force of the heart-beat plays an important part, as Gottlieb* contends, in causing the increase of arterial tension. Thus Szymonowicz reports measurements of the pressure in the external jugular vein made during one of his experiments. According to this report the venous pressure rose and fell with the arterial pressure, which is not what one would expect to occur in the case of a general constriction affecting the arterioles alone. According to Bayliss and Hill,† also, the general venous pressure increases with the rise in arterial pressure. So in a number of the published tracings given by Oliver and Schäffer it appears that the vaso-constriction was more pronounced in the abdominal viscera than in the limbs, since the volume of the latter measured plethysmographically showed an increase of a passive character, apparently, while the volume of the kidney or spleen was greatly diminished.

The significance of the marked reaction exhibited by suprarenal extracts depends very largely upon the possibility of proving that the substance producing the reaction is formed normally within the gland. It is conceivable, of course, that in the dead gland post-mortem changes might cause the formation of a substance giving this reaction, although under the normal condi-

* Gottlieb: Archiv f. exper. Pathologie u. Pharmakologie, XXXVIII., 1897.

† Bayliss and Hill: *Journal of Physiolology*, XVIII. p 352, 1895.

tions of life it might not exist. Fortunately, we have direct proof that the active substance in question is a normal product of the metabolism in the gland. Cybulski and Szymonowicz found that blood drawn from the suprarenal vein, when injected into the circulation of a normal animal, gives the same effect, although less in amount, as extracts of the suprarenal glands, while blood from other veins has no such action. This result has been denied by Oliver and Schäfer, apparently upon insufficient experimental grounds. Langlois,* on the contrary, has been able to corroborate this effect of suprarenal blood, and, in the laboratory at Baltimore, Dr. Dreyer has obtained clear proof of a similar action. It appears from Dreyer's experiments that the effect is not obtained in every animal, but in some cases the results are very positive, and in a matter of this kind the positive evidence is the most important. When we remember that we are dealing most probably with a material formed by the secretory activity of gland cells, and that the amount of this material may vary at different times or under different circumstances, it is not surprising that negative as well as positive results are obtained.

Since it seems certain that the substance does occur under normal conditions in the venous blood flowing from the gland, we are justified in concluding that it is a normal product of the metabolism of the medullary cells of the gland, and that it is discharged or secreted directly into the blood. It must, therefore, exert continually a stimulating effect upon the heart and blood vessels. In corroboration of this last conclusion we have some striking experiments recorded by Szymonowicz which show that after complete extirpation of the two glands the blood pressure becomes greatly depressed. Both Oliver and Schäfer, and Cybulski and Szymonowicz, conclude that the normal function of the suprarenals consists in furnishing this stimulating substance to the blood. The former observers believe that its effect is mainly upon the muscular tissue; that it has a general tonic or augmenting action on all varieties of muscle found in the body—the striated muscle as well as the cardiac and plain muscle tissue. Cybulski and Szymonowicz hold essentially the same general view, except that they believe that the substance acts upon the nerve centers controlling the muscular tissues rather than on these tissues directly. It is, perhaps, impossible at present to decide as to this detail. Oliver and Schäfer have shown, without much doubt, that the substance acts upon the blood vessels after their connections with the central nervous system have been completely severed, and, on the other hand, there is clear proof that it affects at least one part of the central nervous system, namely, the cardio-inhibitory center. Further experimenting will probably soon furnish more definite information upon the extent to which the muscular and the nervous tissues are affected by this substance. Upon either of the views proposed we can understand at once why removal of the suprarenals brings on a condition of muscular asthenia, and why the continual activity of these organs is so essential to the body as a whole. It is significant, in this connection, to recall that Oliver and Schäfer found that extracts of the suprarenals in cases of Addison's disease did not contain this stimulating substance. The hypothesis that the suprarenals secrete a stimulating substance that augments the tone of the muscular system, either directly or indirectly, is not the only one offered to explain the physiology of these bodies. According to some observers the main function of the suprarenals, like that of the thyroids, is to produce an anti-

* Langlois: Archives de Physiologie normale et pathologique, 152, 1897.

toxic secretion capable of neutralizing or destroying certain poisonous products of body metabolism. The toxic products in this case have been supposed to originate in the functional metabolism of muscular tissue, and the asthenic condition following upon extirpation of the suprarenals has been compared with the similar effect produced by injecting the extracts of fatigued muscles into the circulation. The main argument of those who hold to this view seems to rest upon the fact that the blood of an animal that has been deprived of its suprarenals and is beginning to show the typical effects has a toxic effect when injected into the circulation of another animal from which the suprarenals have been removed shortly before. The fatal symptoms are brought on by the injection more rapidly than would happen otherwise. One cannot feel a great deal of confidence in this argument as contrasted with the apparently direct evidence offered in favor of the stimulation hypothesis.

Unfortunately, the physiological evidence with regard to the importance of the suprarenals to the body has not found so satisfactory an application in practical medicine as in the case of the thyroids. Suprarenal extracts and tissue have been used in cases of Addison's disease, but the beneficial effects obtained have not been so clear as in the case of thyroid extracts. Some of the results reported, however, indicate that the method is at least a hopeful one in certain cases.

A third interesting member of the group of ductless glands is the hypophysis cerebri, and a few words may be said as to its supposed physiological activity. This gland is commonly described as consisting of two parts, the anterior and the posterior lobe. The histology and the embryology of the two parts indicate that they are entirely different in origin and in structure. The anterior lobe is evidently a glandular structure. It develops originally as a saccular invagination from the buccal epithelium, and has essentially the same origin in all the vertebrates that have been examined. According to Haller* it is not strictly a ductless gland, since it possesses an imperfectly developed system of ducts that opens between the dura and the pia mater. It is evidently a secreting structure, and the fact that its secretion is discharged between the meningeal membranes suggests some special connection with the physiology of the brain. Histologically its structure recalls that of the thyroid gland, particularly in the fact that a colloidal material is said to occur frequently in the lumina of the gland tubules. In some animals, *e. g.*, the dog and the cat, it is a very small body, but in others, as the rabbit, sheep, ox and man, it is of considerable size and bears every indication in its structure of being an active secretory organ.

The posterior lobe, on the contrary, is very small in all animals and has the appearance of being a rudimentary organ. It develops as an outgrowth from the infundibulum of the brain and is more properly spoken of as the infundibular lobe. Its histology is very incompletely known. According to Berkley† it contains numerous typical nerve-cells, ependymal cells and neuroglia, a number of glandular epithelial cells arranged in part to form tubes or closed vesicles that contain a colloidal material, and some curious structures resembling nerve and organs.

The observations bearing upon the functions of the hypophysis have been limited to the glandular lobe. On the pathological side it has been shown that in many, if not in most, of the cases of acromegalia the glandular lobe exhibits pathological changes. For this reason extracts of the gland have been

* Morphologisches Jahrbuch, XXV., 1896.

† Berkley: The Johns Hopkins Hospital Reports, IV., 1895.

used therapeutically in cases of acromegalia, and, according to some reports, benefits have followed the treatment to the extent that some of the disagreeable features have shown amelioration. The evidence from this side, however, is not satisfactory, and the nature of the connection between acromegalia and disturbance of the function of hypophysis, if any exists, needs more complete investigation.

The experiments made by the physiologists are also meagre and inconclusive. Gley* reports a set of experiments made upon rabbits, in which he attempted to destroy the gland by an operation from above. The experiments were made upon rabbits from which the thyroid lobes had been removed previously, with the idea of demonstrating that a similarity in function exists between the thyroid and hypophysis. All but one of the animals died, owing to the severity of the operation. In the single survivor it was noted that the animal exhibited at times spasmodic muscular contractions and some degree of paresis, and that it died about a year after the operation. On the assumption that the animal would have lived if the thyroid lobes alone had been removed, Gley concluded that the removal of the hypophysis had prevented the parathyroids from replacing completely the loss of the thyroid, and that, therefore, the hypophysis is related in function to the thyroid tissue. Naturally but little importance can be attached to a single experiment of this kind, and, so far as I know, the author has not repeated the investigation. Vassale and Sacchi† claim to have removed the hypophysis partially or completely in a number of animals by an operation through the base of the skull. In cases of complete removal the animal died within a short time—fourteen days or less—after exhibiting a number of symptoms similar to those caused by thyroidectomy, such as muscular tremors and spasms and the development of a cachectic condition. Most physiologists, I fancy, will accept these experiments also with some hesitation until they have been confirmed by other observers. The very severe character of the operation necessary to reach the gland makes it questionable whether the results reported were due to its removal alone, although the experiments were evidently made with great care.

*Gley: Archives de Physiologie normale et pathologique, 1892, 311.

†Vassale and Sacchi: Archives ital. de Biologie, XXII., CXXXIII., 1895; also XVIII., 1893.

Szymonowicz and also Oliver and Schäfer report experiments upon the effects of injections of extracts of hypophysis into the circulation of normal animals. Szymonowicz states that in two experiments he obtained a slight fall pressure and a quickening of the heart-beat. He concludes, therefore, that the physiological action of these extracts is opposed to that caused by extracts of the suprarenals. Oliver and Schäfer, on the contrary, report that extracts of hypophysis exert an effect very similar in some ways to that shown by suprarenal extracts. For instance, they cause a marked rise of blood pressure, together with an augmentation of the heart-beat. Unlike the suprarenal extracts, however, they do not produce a slowing of the heart-rate when the vagi are intact. Upon the basis of these incomplete experiments they draw the somewhat hasty conclusion that the hypophysis and the thyroid are not similar in function, and that the hypophysis is not capable of assuming vicariously the activities of the thyroid.

I have recently made a number of experiments upon this organ, the results of which have been quite uniform and in many respects very different from those obtained by the authors just quoted. My experiments were made with the hypophysis of sheep mainly, although at first the gland of the dog was also used. The extracts were

made in normal saline, or in glycerine followed by dilution with normal saline, and usually the fresh gland was employed. The experiments differed from those reported by others, in that extracts were made separately of the glandular and the infundibular lobe, and the physiological effects of each were tested by injection into the circulation of normal dogs. It was found that the extracts of the glandular lobe have little or no perceptible effect when injected alone. Extracts of the small infundibular lobe, on the contrary, have a distinct and remarkable effect upon the heart-rate and blood pressure, an effect which resembles in some respects and differs in others from that shown by suprarenal extracts.

Briefly stated, these extracts injected into the normal animal with its vagi intact cause a very pronounced slowing of the heart-beat, similar to that caused by suprarenal extracts, but lasting a much longer time. The heart-beat is not only slowed, but is considerably augmented in force, as is shown by tracings taken with a Hürthle manometer. At the same time the blood pressure rises to a considerable extent, owing, apparently, to a peripheral constriction of the blood vessels, since oncometric tracings from the kidney show that this organ shrinks greatly in volume. Usually the constriction of the blood vessels occurs first, so that the pressure rises for about 20 mms. or more more of mercury. This is succeeded sometimes by a temporary fall of pressure during which the heart-rate may be increased, and then the slowing of the heart begins, while the pressure rises again to a greater or less extent above the normal. This last effect continues for a relatively long time and passes off gradually. The slowing of the heart may continue for half an hour or longer. If the dose used is a maximal one, and a second injection is given too quickly afterward, little or no effect is obtained. If, however, the dose is not too strong, and sufficient time is given given for its action to wear of, a repetition of the effects is obtained, and this may occur a number of times, although the effects decrease progressively in intensity.

The effects of the injection are somewhat different if the vagi are previously cut, or if a little atropin is given to paralyze the inhibitory fibres. Under these circumstances the slowing of the heart-rate is very much less marked, although not entirely lacking. In round numbers it may be said that with the vagi intact the heart-rate is reduced about 50 per cent., while in the atropinized animal the reduction is about 20 per cent. It might be added that an animal deeply under ether alone behaves in this respect like an animal with its vagi cut. This result indicates that the slowing of the heart-rate in the normal animal is due in part, but only in part, to a direct action on the medullary centers of the inhibitory fibres. On the other hand, the rise of blood pressure after section of the vagi is greater. Usually the blood pressure rises rapidly for about 20 mms. of mercury; this is succeeded in some cases by a temporary fall, and then the pressure again rises rapidly, reaching a height, in some cases, nearly equal to that caused by suprarenal extracts. During this last phase the heart-beats are slower and more powerful, the effect in this respect differing from that caused by suprarenal extracts. The effect lasts longer than with suprarenal extracts, and a longer interval must be allowed before a new injection will give the same result. I have obtained a marked rise of pressure from injection of extracts of the infundibular lobe, after severance of the cord below the medulla, and in one case after removal of most of the thoracic part of the spinal cord in addition, thus indicating that the constriction of the blood vessels is probably a peripheral effect, and not due to

stimulation of the vaso-motor centers. These observations that I present here only incompletely may be taken to indicate that the infundibular lobe of the hypophysis is, in all probability, not a rudimentary organ, but a structure that has some important physiological activity. Moreover, its function is probably different from that of the glandular lobe, and possibly quite independent of it. With regard to the function of the glandular lobe, the method of injecting extracts into the circulation of a normal animal seems to teach us nothing. While the negative results thus obtained do not oppose, they cannot be said to support, the favorite hypothesis that this part of the hypophsis cerebri has a function resembling that of the thyroid lobes. I venture to suggest that this supposed similarity in function might be tested most satisfactorily upon human beings by feeding the gland in cases of myxoedœma or goitre and ascertaining whether a reaction similar to that caused by the thyroid can be obtained.

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*ON THE RELATIVE VARIATION AND CORRELATION IN CIVILIZED AND UNCIVILIZED RACES.**

THE general conclusion would then be that, with increased civilization, absolute size† and variation tend to increase, while correlation, to judge by the males, is stationary; to judge by the females, tends to increase.

It will be found somewhat difficult to reconcile these results with any simple applications of the principle of natural selection. In the first place increased variation undoubtedly suggests a lessening of the struggle for existence, and there can be no question that this increase has gone on among civilized races (See 'Variation in Man and Woman'). The lessening of the struggle has probably been greater for woman than man; hence the principle of natural selection might help to explain the preponderance of variability in civilized woman. The increase in size with civilization seems, on the average, also incontestable. But is it the effect of lessening the struggle for existence? The possibilities may, perhaps, be summed up as follows:

(*a*) The civilized races may have survived owing to their superior size. It may be a result of the struggle in the past. To this must be objected that the increase of size appears to be a progressive change still going on, and yet increase of variation should show a lessening struggle for existence.

(*b*) The effect of suspending natural selection may be to increase size. This would be a blow for panmixia, for we might naturally have expected a regression to the smallness of the more primitive races. It would leave unexplained the apparently smaller progress of women as compared with men, for in their case we might argue from the variation that the struggle for existence is relatively less than in the case of man.

(*c*) The larger size of the civilized races may be due to better food supply and better physical training; in short, it may be due, not to evolution, but to better conditions of growth. This hypothesis does not involve the assumption that acquired characters are inherited. Diminish the food supply and abolish physical training, and the size would sink to the level at which natural selection had left it. Physical

* Conclusion of a communication made to the Royal Society.

† This is only *generally* true, not in every individual case. The French femur is longer than that of the Aino, of neolithic man, and of the ancient inhabitants of the Canary Islands. On the other hand, the French femur appears to be slightly less than the Libyan, although the humerus is somewhat greater. The French women appear in all long bones less than the Libyan women.

training in civilized races being usually more adequate in the case of man than of woman would, perhaps, explain why man has progressed more rapidly in size than woman. It seems impossible, taking variation as a measure of the intensity of selection, to reconcile the relative increases in size of man and woman with any direct effect of natural selection.

8. To sum up, then, the following results seem *suggested* by these measurements.

(i.) Civilized man has progressed generally on primitive man in size, variation and correlation.

(ii.) This progression can hardly be accounted for by increassd selection (because of the increased variation), not by decreased selection (because it is inconsistent with the relative changes in male and female size). It might possibly be accounted for by decreased selection and improved physical conditions.

(iii.) Woman is more variable than man in civilized races.

(iv.) Woman is more highly correlated than man in civilized races.

(v.) In uncivilized races the sexes are more nearly equal in the matter of size, variation and correlation than in the case of civilized races.

(vi.) It is impossible to say that civilized woman is nearer to the primitive type than civilized man, for while civilized man differs more from the primitive type than civilized woman, so far, probably, as absolute size is concerned, he has made only about half her progress in variation, and hardly any progress at all in correlation.

(vii) The causes (*e. g.*, lessening of selection) which tend to increase variation may also increase correlation. In other words, the intensity of the struggle for existence is not necessarily a measure of the intensity of correlation.*

The measurements made by Mr. Warren on the Libyans, the results of which he has kindly favored us with, are, on the whole, fairly in accordance with the above conclusions. He finds for the

Mean of the sexual ratio of the means..............1.092
" " " the variations.........1.028
" " " the correlations.......1.068

The corresponding quantities for the French are: 1·109, 0·939, 0·956, or, we concluded, that in passing from uncivilized to civilized peoples, from Libyan to French, the men gain on the women in size—here very slightly, and the women gain upon the men very markedly in variation and correlation.

These results are merely suggestions, but they may possibly serve to emphasize the importance of a careful measurement of the long bones of, say, 100 members of both sexes for a series of civilized and uncivilized races. In the former case at least there does not appear to be any real difficulty, except the need of coöperation, in obtaining measurements similar to those of M. Rollet, for both English and Germans. The value of such statistics for comparative purposes would be very great.

ALICE LEE,
KARL PEARSON.

* The mathematical theory of selective correlation shows that the close selection of an organ, say the femur, may actually tend to reduce the correlation between two other organs, say the humerus and the radius.

MIGRATION OF THINGS AND OF MEMORIES.

IN the minds of some students the question of migration of forms is frequently confounded with that of the migration of tribes. It must not be forgotten by those who are carefully studying the origin of industrial forms on the Western World that there were daily mails delivered on the American shore from the Eastern Continent, from the remotest antiquity.

The United States Navy has been dropping bottles overboard in the Atlantic

Ocean, at the Azores, in deep water along the coast of Spain and from the Madeira and the Canaries southward along the coast of Africa. All of these bottles that have been recovered have been found on the coast of South America, on the Antilles, and some of them as far west as the mouth of the Rio Grande. It can be inferred from this therefore, that every buoyant object which has been dropped into the ocean during the present geological epoch by prehistoric or historic Spaniards, Portuguese or Africans has found its way to America and been stranded somewhere between the 10th parallel south and the 30th parallel north.

In the northern part of the Atlantic Ocean the currents run the other way and the mails have been delivered from America to Europe. In the Pacific Ocean the daily mails delivered on the west coast of America from Mount Saint Elias southward have proceeded from about the 20th parallel north, in the vicinity of the Malay Peninsula and Archipelago, thence have travelled through the China Sea and the Japanese Sea to pick up objects designed for the Western Hemisphere.

In the Southern Hemisphere the mails travel the other way and materials consigned to the Ocean Current Company were taken from Chili and Peru to be delivered upon the Easter Island and the various groups of Polynesia, some of them reaching as far as Melanesia. In addition to these great mail services of the Pacific there was a narrow strip of service called the 'counter-current' between the equator and the 10th parallel north, the articles consigned to it being delivered on the west coast of Central America.

In the Arctic Ocean the mails proceeded from west to east, passing up through Bering Strait, across the Pole, and finding their way first to east Greenland and then around Cape Farewell to the southwestern shores of that great island. The Arctic current from Baffin Land and northward brought the mails from the Eskimo area southward even as far as Charleston, South Carolina. The consequence of such uninterrupted communication cannot be overestimated. All who have studied the arts of primitive races know how quickly their plastic minds respond to a congenial suggestion. It would not even be necessary for a Chinese or Japanese vessel to bring a single living teacher to take part in the pedagogic work of instructing the West Coast tribes in eastern Asiatic arts.

The recent example of a throwing stick which drifted from Port Clarence, south of Bering Strait, and was picked up on the shores of west Greenland by Dr. Rink, is one of an interrupted series of communications between one of those great mailing stations and another. A second element in technical pedagogy has not been emphasized by any modern writer, and yet it cannot be overlooked; and that is the survival of industrial processes and productions in the myths and traditions of wandering tribes, so that one of them having passed over a long area where a certain kind of activity was not demanded, and coming again to a place where the conditions are favorable to its revival, changed a song or an ancient tribal memory into an actual fact again.

O. T. MASON.

FIELD WORK OF THE UNITED STATES GEOLOGICAL SURVEY.

THE plans of operation of the United States Geological Survey for the fiscal year 1897–1898 have been approved by the Secretary of the Interior and the work of the field season of 1897 has been started, the parties having all taken the field. The sums appropriated for the Survey this year were given in detail in a recent issue of SCIENCE, separate amounts being set apart for specific branches of work and for the

salaries of persons connected with these branches, making the aggregate amount for the Geological Survey for the fiscal year 1897–'98 $967,840, a decided increase, though the additional sum does not go to the geologic branch.

For convenience in administration the work of the Survey is divided into four branches, each of which is again separated into a number of divisions. The branches are geology, topography, publication and administration; geology and topography being the main branches.

In geology the field work extends all over the United States from New England to the Pacific. Professor N. S. Shaler, of Harvard University, is at the head of a party which will continue the work begun last year of the survey of the Richmond coal basin of Virginia. Professor Walcott says in his report: "Although these Virginian fields are apparently remote from the New England region, the geologic problems are closely related to those which Professor Shaler has particularly studied, and it is convenient to continue the work under his direction." Professor Shaler has already completed the study of the Narragansett coal basin in Massachusetts and Rhode Island, and the publication of results has been begun; and a report on the Cape Cod geology is also proposed for publication.

A party under Professor Emerson is continuing his work of the last six years in studying the crystalline schists in eastern Massachusetts, and one under Professor T. Nelson Dale, in cooperation with Professor Wolff, will extend the work of previous years north and east to cover the area of the Bennington (Vt.) quadrangle. The study of the roofing-slate belt of New York and Vermont has been completed. Professor Kemp, of Columbia University, goes to the southeastern Adirondack area to work on the mapping of that section.

Professor J. E. Wolff will make a special study of the crystalline rocks of northern New Jersey, including zinc and iron ore deposits. He will also complete the survey of the Franklin (N. J.) quadrangle. He will also assist Professor Dale, as above mentioned. Mr. David White will study the coal deposits of Ohio, Pennsylvania, Virginia, West Virginia and Tennessee, from a paleobotanic standpoint, and Mr. M. R. Campbell will continue the study of the distribution of the coals of West Virginia and Kentucky. Mr. J. A. Taff will inaugurate work in the coal fields of Indian Territory. Dr. C. Willard Hayes' work in the southern Appalachian province has been brought to such a stage of development that he will prepare a monographic report upon it. Mr. Arthur Keith will continue the mapping of the crystalline rock areas in which he has been engaged, extending from the northern line of Maryland to North Carolina. His work is directed to an elucidation of the obscure geologic relations of the rocks of the Blue Ridge and Piedmont Plateau and their bearing upon geologic history.

Two parties will be sent to the Coastal plain region. One, under Dr. William B. Clark, of Johns Hopkins, will study the Cretaceous formations, which include the marl and clay beds of Maryland and New Jersey, and one under Mr. George H. Eldridge, who has been working for the past year on his report of the phosphate deposits of Florida, will spend the summer in the Atlantic Coast plain region.

Seven parties have been sent to the interior Mississippi region, and five to the Rocky Mountain region which lies between the British and Mexican boundaries on the north and south, the margin of the great plains on the east, and, approximately, the line of the 119th meridian on the west, and embraces the Rocky Mountains and their foothills. Mr. Arnold Hague is in charge

of one of these parties, which will do the field work necessary to enable him to complete his monograph on the Yellowstone National Park. This was interrupted by his work on the Forestry Commission of the National Academy of Sciences last year. Professor Hague will survey the Absaroka Range, one of the most rugged and inaccessible of the Rocky Mountains. Dr. W. H. Weed will continue the study of ore problems, etc., in Montana.

Mr. S. F. Emmons will be in Europe the greater part of the season, but under his direction surveys of the Tintic mining district of Utah will go on.

The Pacific region is covered by five parties, but the appropriation of $5,000 made for work in Alaska was not passed in in time to be available during the present year.

The paleontologic work is to be continued on the same lines as during the last year. "Special attention," says Professor Walcott, "will be given to the identification of certain fauna and flora in the coal regions of the Appalachians and the Rocky Mountains, and a thorough study will be made of the Cretaceous fauna of Colorado, Texas and Kansas, and the Tertiary fauna of California and Oregon, with relation to areal and vertical distribution, for the purpose of aiding the geologist in the solution of problems in areal geology. This will require that several members of the paleontological force shall continue field work, either independently or in connection with geologic parties."

It is also proposed to continue the collection and publication of data touching the mineral resources of the United States. Dr. D. T. Day has direction of this work, and $20,000 has been specifically appropriated for it.

One hundred and seventy-five thousand dollars has been allotted for topographic surveys proper and $150,000 for forestry surveys, and the plan of work will not be changed in character and organization from that of last year, except that additional work is imposed by the survey of the forest reserves.

The work of subdivision and topographic mapping in the Indian Territory is continued under C. H. Fitch, with the same organization as last year. Mr. Fitch expects to complete his field work by December 1st, with the exception of the resurvey of the Chickasaw Nation, for which $141,500 has been especially provided.

THE PHYSICAL SOCIETY OF LONDON.

THE Physical Society of London (or, as it is more generally called, the Physical Society) was founded in 1874 and was the outcome of a movement set on foot by the late Professor Frederick Guthrie, at that time professor of physics in the institution now known as the Royal College of Science. Among the original members of the Society were Professor W. G. Adams, Dr. Edmund Atkinson, Mr. Crookes, Professor Carey Foster, Dr. Gladstone, Professor Guthrie, Mr. Haddon, Professor John Perry, Professor A. W. Reinold and Professor Tyndall.

The purposes of the foundation were the receiving and discussing communications relative to physics, the exhibition of apparatus for physical research and of experiments illustrating physical phenomena and the publication of communications made directly to the Society and of other papers relating to physics.

Through his official connection with the Royal College of Science, Professor Guthrie was able to secure the consent of the Lords of the Committee of Council on Education, who are the authorities having jurisdiction in the matter, to the meetings of the Society being held in the physics lecture room of the College of Science and to the use of the physical laboratory and apparatus of the

College for the experimental illustration of papers read. The Society was thus relieved of all charges for rent of its meeting room and was consequently able to carry on its work without charging a larger subscription than one pound a year, or a single payment of ten pounds as a life composition for annual payments, with an entrance fee of one pound.

On this slender financial basis a very large amount of good work was done. Not merely were Proceedings issued containing the papers which had been presented to and accepted by the Society, but the works of Joule and of Wheatstone were printed in extenso and distributed to the members. Similarly were published in English Helmholtz's Memoir 'On the Chemical Relation of Electrical Currents,' Hittorf's Memoirs 'On the Conduction of Electricity in Gases,' Puluj's Memoir on 'Radiant Electrode Matter' and Van der Waal's Memoir 'On the Continuity of the Liquid and Gaseous States of Matter;' a useful work of reference by Mr. Lehfeldt entitled 'A List of the Chief Memoirs on Physics of Matter' and a table of 'Hyperbolic Sines and Cosines' by T. H. Blakesley.

The founders of the Society purposely avoided setting up a new journal, being of the opinion that the unnecessary multiplication of the sources to be consulted in search of scientific facts was a thing to be avoided. By an agreement with the proprietors of the *Philosophical Magazine* it was arranged that such of the papers read before the Society as the Council might decide to publish should, in the first instance, be printed in that magazine, and afterwards collected and issued to the members of the Society in the form of Proceedings. A large circulation was thus at once secured and the creation of an an additional physical journal avoided.

As the Society grew it became desirable that it should have a local habitation not far from the other leading scientific societies of London, and the Council were fortunately able to make arrangements with the Chemical Society, whereby since 1894 the meetings have been held in the rooms of the latter Society in Burlington House.

In 1895 the Proceedings of the Physical Society, which had hitherto appeared at irregular intervals, began to be published in monthly parts, and at the same time the Society began the publication of Systematic Abstracts of papers in Physics printed in foreign journals. It is hoped that these Abstracts will be of great use in facilitating a knowledge by English-speaking physicists of the work which is being done by their colleagues in other countries. The increased activity of the Society has involved an increase of expenditure, and to meet this it has been necessary to raise the subscription payable by members. At the present time the annual subscription is £2 and 2s.

The number of members is over 400 and and the list includes nearly all the leading physicists of the United Kingdom.

The Regulations of the Society provide for the election of a limited number of foreigners as honorary members, and in this way some of the most distinguished physicists in many countries are connected with the Society.

CURRENT NOTES ON ANTHROPOLOGY.

THE NATIVES OF THE PHILIPPINES.

It is well known that the Philippine Islands had when first discovered by Europeans two quite different classes of population. On the coast was a light colored race similar to the Malayo-Polynesians and speaking an allied dialect. In the interior was a small-sized, black race, called by the navigators 'Negritos.' In the Proceedings of the Prussian Academy of Sciences, 1897, No. XVI., Professor Virchow figures and describes a large deformed skull from a cave in the Archipelago, which, in its antiquity

and similarity to some others exhumed on other islands, suggests the probability that it comes from a prehistoric race, older than either of those mentioned, and perhaps not belonging among the Malayan stock.

With regard to the Negritos, Professor Virchow expresses the opinion that they are a 'primitive' type; at the same time he throws out various speculations on the rapidity and uncertain limits of variation in man, how much it arises from environment, etc, so that the reader almost expects him to say that originally the two types of the Philippines might have been one.

It should always be remembered that the so-called 'Law of Variation' in organic forms is a purely negative expression, formulating merely non-identity, and can have no other limits than those temporarily established by observation.

WAMPUM AND STONE MASKS.

PROFESSOR E. T. HAMY, well known for his numerous American studies, and now President of the Society of Americanists of Paris, has lately published two articles in the journal of the Society of considerable interest.

One is a description of a wampum belt believed to be of Huron manufacture, transferred, it is suggested, at the treaty made by Frontenac in 1673. A full examination of the beads and the method of boring would be desirable, in order to ascertain its antiquity.

The second paper is on a stone mask brought by M. Pinart from the Northwest coast. Its traits are allied to those of the wooden mask, but as an example in stone from that locality it is believed to be unique.

Another subject, to which Professor Hamy has devoted a short article in the *Compte Rendu de l'Academie des Inscriptions*, is a series of six ancient portraits of the Incas of Peru, of unknown provenance, discovered in an old house at Rochefort. They are especially interesting as showing the sumptuous official costume worn by the ancient monarchs of the Quichuas.

NATIVE AMERICAN ART-MOTIVES.

DR. H. STOLPE, of the Stockholm museum, Sweden, who probably stands at the head of European students of aboriginal art, has lately published an elaborately illustrated folio entitled 'Studies in American Ornamentation,' of which there is an extended notice in *Globus.*

He examines with patient care the art-motives of a number of tribes of North and South America. His investigations show that in nearly all examples the oldest decoration was anthropomorphic or zoomorphic. Emblems of the wind, the water, etc., also occur. A certain number are figured of which the interpretation is obscure.

Dr. Stolpe is severe on Hamy, Schurz and other modern writers who, in the face of well-known principles of scientific investigation, spend their time in seeking out analogies with the Old World in ancient American art. He has not found a trace of such cultural connection, and declares that wherever the material has been abundant all native American art-development can be proved to have been indigenous.

It is to be hoped that this work, which is in Swedish, will soon be translated into English.

D. G. BRINTON.
UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

As briefly noted in SCIENCE, fluorin has been at last liquefied. Professor Moissan, of Paris, brought all his apparatus for the production of fluorin to the Royal Institution, where he could avail himself of the

unrivalled appliances for the production of intense cold, as well as of the assistance of Professor Dewar. An account of the experiments is given in the *Comptes Rendus*, and with notes by Professor Crookes in the *Chemical News* of June 11th. The difficulties encountered in the liquefaction of fluorin are its intensely corrosive action and its very low temperature. Several liters of liquid oxygen, the refrigerant, were used in the research. Happily, at very low temperatures fluorin loses much of its chemical activity, no longer attacking glass. Fluorin becomes liquid at —185° C., is clear yellow and possesses great mobility. At this low temperature silicon, carbon, sulfur, phosphorus and reduced iron previously cooled in liquid oxygen and then placed in an atmosphere of fluorin, do not become incandescent, and the iodin of potassium iodid is not displaced by fluorin. Benzene and turpentine are, however, decomposed with incandescence when the temperature rises to —180 C., showing the great affinity of fluorin for hydrogen. Note is made of the fact that when fluorin is passed through liquid oxygen a white flocculent precipitate is formed, which when filtered off deflagrates with great violence as soon as the temperature rises. It would seem to be a compound of fluorin and oxygen, and is being further investigated.

In a recent *Comptes Rendus*, Berthelot and Vieille give an account of further investigations on the dangers attending the storage of acetylene. They had previously shown that, if under less than two atmospheres pressure, acetylene cannot be detonated by fulminates or by red-hot wire. They now show that acetone is a good solvent for acetylene. While such a solution is still capable of explosion, it is much safer than the gas alone, and the pressure at which an explosion is possible is raised from two to ten kilograms per square centimeter. In a large vessel the amount of acetylene that can be safely stored is fifty times greater with the acetone than without it.

At the conference of the Institution of Civil Engineers, held in London the last of May, Professor Biles read a paper before the Shipbuilding Section on 'Improved Materials of Construction.' In the course of the discussion which followed it was strongly brought out that nickel steel is the coming material for ship building, provided its cost can be made satisfactory. For this, it was said that new deposits of nickel must be discovered and the cost of its metallurgy must be reduced.

The *Engineering and Mining Journal* gives a report of the Carborundum Company for 1896, by which it appears that the output of crystalline carborundum for last year was nearly six hundred tons. It seems probable that the amorphous carborundum formed in the manufacture, which has heretofore had no use, will ultimately displace ferro-silicon in the manufacture of steel. Germany alone would use 2,500 tons of carborundum annually if it could be furnished at not over six cents a pound, and the Carborundum Company claims it can do this.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

We are informed that the preliminary programs for the meetings of the sections of the American Association for the Advancement of Science promise many interesting papers and a large attendance. No less than twenty-five papers have already been entered to be read before the physical section, including contributions from a number of leading physicists, and other sciences will be equally well represented. We hope to publish in advance of the meeting the full programs for all the sections.

The fourth summer meeting of the American Mathematical Society will be held, as we have already announced, at Toronto, Canada, on Monday and Tuesday, August 16th and 17th.

It will thus immediately follow the adjournment of the American Association for the Advancement of Science from Detroit to Toronto, and immediately precede the opening of the Toronto meeting of the British Association for the Advancement of Science. The committee of arrangements announce that by invitation of the University of Toronto the Society will meet in the main building of the University. The Society will be called to order by the President, Professor Simon Newcomb, on Monday morning at 10 o'clock, and the Council will meet Monday evening. The committee has decided to set apart one of the sessions during the meeting for the general discussion of the following subjects: (1) The accurate definition of the subject-matter mathematics. (2). The vocabulary of mathematics. The possibility of correcting and enriching it by cooperative action. In connection with the former of the subjects, reference may be made to the Presidential address of Mr. A. B. Kempe before the London Mathematical Society (Proceedings of the London Mathematical Society, Vol. 26, pp. 5–15). No special railroad rates to and from this meeting have been secured, but members are entitled to special rates for the numerous excursions arranged in connection with the meeting of the British Association. Members may join the British Association on payment of five dollars. Members of the American or of the British Association secure reduced rates to and from the meeting through those bodies.

Mr. C. L. Marlatt, Secretary of the Association of Economic Entomologists, writes us that the annual meeting of the Association for 1897, which was announced for the two days preceding the general sessions of the American Association for the Advancement of Science at Detroit, viz., August 6th and 7th, has arranged for its sessions on Thursday and Friday, August 12th and 13th, during which time Section F will hold no meetings, closing its work on Wednesday, the 11th. It is believed that this arrangement will give better satisfaction to the members of the Association of Economic Entomologists, most of whom are also members of Section F, and will be a saving of time. The Russell House will be headquarters. A new feature of interest which will be introduced this year will be reports from various foreign members of the Association on the worst insect pests of the year in their respective countries. The titles of papers should be sent promptly to the Secretary to be inserted in the provisional program. General information relating to hotel accommodations, railroad rates, etc., is given in the preliminary announcement recently issued by the American Association for the Advancement of Science, and, if any of the members have not received this circular, they may obtain it, or any other desired information of similar nature, by writing to the Local Secretary, A.A.A.S., Mr. John A. Russell, 401 Chamber of Commerce, Detroit, Mich.

Among the very numerous jubilee honors conferred by Queen Victoria we notice that Sir William MacCormac, President of the Royal College of Surgeons; Dr. Samuel Wilks, President of the Royal College of Physicians, and Mr. James Pender, who carries on much of his father's work in connection with telegraphs, have been made baronets. Professor William Crookes, Dr. W. G. Gowers and Dr. Felix Semon have been made knights. The K. C. B. has been conferred upon Professor J. Norman Lockyer, Dr. William Huggins, Mr. J. Wolfe Barry and Dr. Edward Frankland, and the C. B. on Mr. W. H. M. Christie, Astronomer Royal.

Yale University has conferred the degree of LL.D. on Dr. T. Mitchell Prudden, professor of pathology in Columbia University.

Harvard University has conferred the degree of A.M. on Professor Franklin W. Hooper, of the Brooklyn Institute of Arts and Sciences.

Trinity University, of Toronto, will confer, at the approaching meeting of the British Association, the honorary degree of D.C.L. on Sir John Evans, President; Lord Lister, Lord Rayleigh, Sir John Lubbock and Dr. Forsyth.

Mr. Ernest B. Forbes, of the University of Illinois, has been appointed Assistant State Entomologist in Minnesota.

F. V. Coville, Chief Botanist of the Department of Agriculture and Curator of the National Herbarium, has just gone to Oregon, to investigate the effect of sheep herding on the vegetation of the Cascade Range, and to conduct botanical investigations.

A DISPATCH to the London *Times* states that Lieutenant Eldred Pottinger and Mr. Lawrence, who, with a small party of Gurkhas, have been engaged for some months past in exploring the sources of the Irawadi, were attacked by Black Mairus on the night of May 22d. A native surveyor and one Gurkha were killed, and two Gurkhas were wounded. Lieutenant Pottinger and Mr. Lawrence escaped with the rest of the party, bringing the wounded men with them, and after great hardships arrived in Chinese territory.

THE death is announced of Dr. Japetus Steenstrup, formerly professor of zoology at the University of Copenhagen, and known for his contributions to natural history and paleontology, at the age of eight-four.

THE trustees of the National Portrait Gallery, London, have purchased a portrait of Sir Joseph Richardson, sometime British Secretary of State and the second President of the Royal Society. The Gallery has received by presentation a portrait of Francis Ronalds, one of the inventors of the electric telegraph, and a bust of Richard Jeffries, naturalist and author.

A BRONZE statue of Benjamin Franklin, representing Franklin seated in heroic proportions, will be presented to the City of Philadelphia by Mr. Justice C. Strawbridge and erected on the spot where Franklin laid the cornerstone of the first building of the University of Pennsylvania.

THE committee on an international memorial to the late Sir John Pender, whose appointment we announced some time since, has already received subscriptions amounting to about £6,000. It is proposed to place a bust of Sir John Pender in some suitable institution, to endow with £5,000 a Pender chair of electrical engineering in University College, London, and to establish a Pender scholarship and a gold medal at Glasgow University.

MR. JOHN RUSSELL YOUNG, a newspaper correspondent, not known to have made any study of library management or methods, has been appointed by President McKinley head of the new Congressional Library. Mr. A. R. Spofford will remain connected with the library as First Assistant Librarian. Mr. Bernard R. Green, who, with the late General Thomas L. Casey, supervised the construction of the library building, has been appointed Superintendent of the Buildings and Grounds.

SECRETARY SHERMAN has, under an authorization in the recent sundry civil appropriation bill, changed the title of the Bureau of Statistics of the State Department to that of Bureau of Foreign Commerce. The old title tended to confusion with other bureaus and did not properly describe the work of the bureau, which deals with the collection of reports of consular officers on foreign commerce and their distribution to the business community.

A COMMITTEE has been appointed by the Treasury Department to make an investigation of the U. S. Coast and Geodetic Survey, with a view to learning whether the efficiency of the department, especially its field work, can be improved. Professor W. G. Reymond, of the Rensselaer Polytechnic Institute, and Mr. Octave Chanute, of Chicago, have been appointed members of the committee, one place remaining to be filled.

THE New York Zoological Society has begun the publication of a *News Bulletin*, intended to increase interest in the work of the Society. The first number contains, in addition to items of news, an illustrated articles on the Zoological Park, reprinted from *Harper's Weekly*. The Society proposes to hold, next winter, an exhibition of paintings and sculptures of American wild animals. The plan for the grounds and buildings of the park will soon be completed.

THE specifications for the new wing of the American Museum of Natural History, New York, have been approved by the Park Board, and bids for the building will soon be opened.

THE Natural History Building of the University of Illinois was struck by lightning on the morning of June 17th, and partially destroyed. The collections, apparatus and libraries of the Illinois State Laboratory of Natural History, the Biological Station and the Agricultural Experiment Station were saved, with slight damages by water. The damage to the building is estimated at $3,000. The loss in apparatus, principally in geological and botanical departments, is nearly $5,000.

THE steamship Hope, commanded by Captain John Bartlett, has been again chartered by Lieutenant Peary, who will leave Boston to join the steamship between July 10th and 12th.

THE daily papers state that additional details of the eruption of the Mayou volcano, in the Province of Albany, Philippine Islands, show that 120 of the inhabitants of the village of Liboug perished. The village was greatly damaged and the tobacco crop of the vicinity was destroyed. The eruption was accompanied by an earthquake, the shocks being felt over an area of one mile. The volcano of Mayou has not been active since 1617.

THE third session of the Greenacre lectures opened on July 1st and will continue until September 3d. Daily lectures are given on subjects of scientific, literary and philosophical interest. The congress will take advantage of the meeting of electrical engineers at Greenacre and announces as part of the program lectures by Professors Barker, Brackett, Duncan, Crocker, Pupin, Cross and others.

THE International Institute of Bibliography at Brussels announces the holding of its second conference, August 2–4, 1897.

THE *American Journal of Archæology*, hitherto edited by Professor A. L. Frothingham, Jr., has been transferred to the Archæological Institute of America, and will hereafter be published in a second series by the Macmillan Company. Professor John H. White, of Harvard University, will be the editor-in-chief, with Professor James R. Wheeler, of Columbia University, and Professor Allan Marquand, of Princeton University, as assistant editors.

DR. PERSIFOR FRAZER, who, at the wish of the late Professor Cope, has been for two months acting as managing editor *pro tem.* of the *American Naturalist*, has been succeeded temporarily by Mr. A. M. Brown, of Philadelphia.

Natural Science calls attention to the fact that over a century ago there was founded a zoological record, viz., F. A. A. Meyer's *Zoologische Annalen*, which was published at Weimar in 1794, and ran for one year only. Meyer gave an account of zoological works issued up to Easter and up to Michaelmas, 1793, an aphabetical list of all living zoologists, an account of all the zoological collections known to him, and a sketch of all the new animals described during the year, in systematic order.

MR. A. W. BENNETT will succeed Professor F. J. Bell as editor of the Journal of the Royal Microscopical Society.

A *Zeitschrift für comprimirte und flüssige Gase*, edited by Dr. M. Altschul, will herefter be published in Berlin by L. Esterman. The first number was opened by an article by Professor Raoul Pictet, followed by articles by Professor H. F. Wiebe and Professor M. Thiesen.

IT is noted in *Industries and Iron* that according to a recent American Consular report, at a place called Tongshan, about eighty miles from Tien-tsin, the Chinese have established extensive railway carriage building works, in which the rolling-stock for the extension of the railway is being constructed. Only the axles, wheels, springs and couplers are imported, and the Consul expresses himself as surprised at the excellence and finish of the passenger carriages turned out by native labor. The Chinese Engineering and Mining Company have attained an output of 2,000 tons of coal daily from the mines in the vicinity, and large extensions are being contemplated.

WE have already announced that next year Captain Sverdrup proposes to take the Fram up Smith Sound to the northwest coast of Greenland, for the purpose of prosecuting explorations in that direction. The London *Times* states that, though Dr. Nansen will not accompany the party, there is reason to believe that he is taking an active share in the direction of the expedition. The object will be to penetrate north through Smith Sound and Robeson Channel as far as possible along the northwest coast of Greenland. An attempt will be made to discover how far Greenland extends northward, and to survey the northwest, north and northeast coasts. In short, one prime object will be to complete the exploration of the Greenland coast, a considerable extent of which is still quite unknown. It will be remembered that Lieutenant Peary carried explorations further eastward than had been previously

done. The task will be a difficult one, even if Captain Sverdrup succeeds in taking the Fram through the difficult ice navigation which is generally found between the Greenland and American shores. Still, as we know from Hall's experience, there are years when the passage is quite clear, and if the conditions are favorable the Fram may succeed in reaching 82° N. without difficulty. Dr. Nansen is also anxious that Captain Sverdrup should examine what has been called the 'paleo-crystic ice,' about which there has been so much discussion, and as to the origin and real character of which there is considerable doubt. An attempt will be made to discover how far one must travel from land with dogs and sledges before meeting with ice more like that in which the Fram drifted.

COMMISSIONER HERRMANN, of the General Land Office, has formulated, for the approval of the Secretary of the Interior, Regulations for the Forestry Reserves of the United States, following the recommendations of the Committee of the National Academy, published in a recent issue of this JOURNAL. Attention is called to the danger of forest fires and to the law providing for punishment by fine or imprisonment, not only for willfully setting fire to any timber on the public domain, but also for letting fires burn unattended near any timber. The recommendations would allow prospecting and the development of mineral resources, and land for school houses and churches are provided. The construction of wagon roads and irrigating canals is permitted. The pasturing of live stock is allowed, except of sheep in regions where the rain fall is limited. Owners of mines and settlers resident within the forest reserves are permitted to take firewood, fencing and building material when they have not a sufficient supply on their own claims. Provision is also made for the sale of timber when this will not interfere with the value of the forests. Instructions are issued to all special agents of the Interior Department regarding the prevention of injury and depredations. It is further provided that lands more useful for mining or agricultural purposes may be eliminated from the forest reserves and restored to the public domain. Subject to the surveys now being made by the Geological Survey, portions of the suspended reserves may be restored to public entry, and other portions of the public domain may be included in them.

AN article in the London *Times* entitled 'On the Trail of a Ghost,' regarding an alleged haunted house in Perthshire, Scotland, has been followed by numerous letters on the subject. Two of these, one by Professor John Milne, offer the plausible explanation that the noises are of seismic origin. Perthshire is a center for British earthquakes. As early as 1840 the British Association appointed a committee to investigate the Perthshire earthquakes, and instruments were established in the parish church at Comrie. As many as 465 shocks were noted there between 1852 and 1890, and sounds may be heard when no movement can be either felt or recorded by an ordinary seismograph. Mr. Milne suggests that "The Society for Psychical Research when on bogey-hunting expeditions might possibly find that the suggested use of tromometric apparatus might not only lay home-made ghosts, but would furnish materials of value to all who are interested in seismic research."

WE learn from *Industries and Iron* that the Lachine Rapids, Hydraulic and Land Company, organized in 1895, to use the great energy of the Lachine Rapids, near Montreal, will soon complete its installation. There will be about eighty-six turbine wheels shortly in operation, and twelve dynamos making 175 revolutions each with a generating pressure of 4,400 volts. The electric energy will be carried by overhead wires as far as the outskirts of Montreal, and then passed underground until it reaches the substation in the city.

THE supply bill passed at the recent session of the New York Legislature contained an item appropriating $10,000 for the medical department of the University of Buffalo to investigate the causes, nature and treatment of cancer. Governor Black vetoed this appropriation with the statement: "I cannot approve a proposed policy which requires the State to engage in an investigation of the causes of various diseases with which the human family is afflicted. I think that the interest of the people themselves

and the skill, intelligence and enterprise of physicians may be depended upon to make an investigation."

THE laboratory courses in biology at Wesleyan University will be conducted next year by Mr. Estin during the absence of Professor Conn in Europe.

THE Berlin correspondent of the London *Times* writes that, at the recent Medical Congress, Professor Liebreich, who may, perhaps, be described as the leader of the anti-Koch party in the Berlin scientific world, stated his theory of tuberculosis as opposed to Professor Koch's. Phthisis, he said, might be present without tuberculous bacilli as concomitants. The reception of tuberculous bacilli into the system had an injurious effect only in cases where there existed a predisposition to disease, and thus the bacilli were only parasites. It was a radically false method to attempt merely to deliver a consumptive patient from the presence of bacilli. The chief thing was to increase the vital power of the cellular tissue. Cantharidine was a specific capable of producing this result. Was there any method of disinfecting the cellular system? In Professor Liebreich's experience he found that etherized oil of mustard had this effect. The lecturer did not think that the therapeutic systems which had been built up on the basis of bacteriology were defensible. The results obtained with diptheritic serum were apparent rather than real. Professor Koch's method of treating tuberculosis had no prospect of ultimate success. Professor Liebreich's views were summarized in the sentence: "Tuberculosis is a 'nosoparasitism,' and the essential feature of the disease is the deterioration of the organism." Several subsequent speakers of eminence strongly combated Professor Liebreich's assertions, urging in particular the indubitable successes obtained with diphtheritic serum.

UNIVERSITY AND EDUCATIONAL NEWS.

THE Hull Biological Laboratories of the University of Chicago were formally dedicated on July 2d. The presentation was made by Miss Helen Culver and the acceptance acknowledged by the President. The dedicatory address was made by Professor William H. Welch, of the Johns Hopkins University, his subject being 'Biology and Medicine.' The laboratories were open to inspection in the afternoon. A dinner was given to the visiting biologists before Professor Welch's address and a reception was given afterwards by the members of the biological faculties to Miss Culver and Professor Welch.

THE University of Chicago will erect a new building outside the University grounds which will contain the plant for power, light and heat, the extensive printing and bookbinding establishment and a retail bookselling and stationery department.

THE trustees of the College of the City of New York have approved the purchase of a site on Convent Avenue, and have authorized the executive committee to select plans for the buildings.

PRESIDENT G. J. KOLLEN, of Hope College, situated at Holland, Mich., announced at the recent commencement that $100,000 had been subscribed for the College by various donors.

BY the will of the late Dr. John T. Atwater, of Poughkeepsie, N. Y., Yale University receives land valued at $25,000.

THE Ohio Supreme Court has handed down a decision that gives the Ohio State University the estate left by the late Mr. Henry F. Page, consisting of farms and personal property, the exact value of which is not known.

THE Thirty-fifth University Convocation of the State of New York met at Albany from the 28th to 30th of June, with a large attendance of those interested in higher education. Addresses were made by Chancellor Upson, Governor Black and President Canfield, of the Ohio State University. The first morning was devoted to the teaching of science, papers being presented on the 'Present Trend of Geography,' by Professor W. M. Davis, Harvard University; on 'Methods of Teaching Botany in the Secondary Schools,' by Professor Geo. F. Atkinson, Cornell University; on 'The Proper Use of Library and Laboratory in Teaching Physical Science in

the Secondary Schools,' by Professor John F. Woodhull, Teachers' College, New York; on 'The Practical Study of the Brain in a Primary School,' by Professor Burt G. Wilder, Cornell University, and on 'The Place of Electricity in the College Curriculum,' by Brother Potamian, Manhattan College. These papers were discussed by Professor A. P. Brigham, Colgate University; Professor E. L. Nichols, Cornell University; Professor W. LeConte Stevens, Rensselaer Polytechnic Institute, and others. Among other subjects considered by the convocation were Athletic and Oratorical Contests, Instruction in Ethics in Secondary Schools, The Relations of the College to the University and a National University, under which latter subject Professor R. H. Thurston, Cornell University, read a paper entitled, 'The National University and Technical Education.' In some remarks on the work of the University, Regent T. Guilford Smith called special attention to the work in geology and botany of Dr. F. J. H. Merrill and Mr. J. A. Lintner.

THE New York State Teachers' Association met at the Normal College, New York, from June 30th to July 2d, with about 2,000 members in attendance. There was a nature study section in which papers were read on 'Nature Study in a Crowded City,' 'The Use of the Microscope,' 'The Mounting of Botanical Specimens,' 'Literary Aids,' and other subjects of interest to teachers of science in the schools. A State Society for Child Study was organized with Mr. George Griffith, of Utica, as President, and Professor M. V. O'Shea, recently elected professor of pedagogy at the University of Wisconsin, as Secretary and Treasurer.

DR. CHARLES E. BEECHER has been promoted to a University professorship of historical geology at Yale University, and Dr. L. V. Pirsson to a professorship of physical geology in the Lawrence Scientific School.

DR. F. E. HULL, of Toronto University and the University of Chicago, has been appointed to the chair of physics in Colby University, vacant by the resignation of Professor William A. Rogers.

THE following promotions and appointments have recently been made by the Trustees of the Johns Hopkins University: John M. T. Finney, M.D., now associate, to be associate professor of surgery; Lorrain S. Hulburt, Ph. D., now associate, to be collegiate professor of mathematics; James E. Humphrey, S.D., now lecturer, to be associate professor of botany; William J. A. Bliss, Ph.D., now assistant, to be associate in physics; N. Ernest Dorsey, Ph. D., now fellow, to be assistant in physics; William T. Mather, Ph.D., now fellow, to be assistant in physics; George B. Shattuck, Ph. D., now fellow, to be assistant in geology; Oliver L. Fassig, S.B., of the U. S. Weather Bureau, to be instructor in climatology; Charles R. Bardeen, M.D., to be assistant in anatomy.

FELLOWSHIPS at the Johns Hopkins University have been awarded as follows: F. S. Conant, Zoology (the Bruce fellowship); Cleveland Abbe, Jr., Geology; G. A. Drew, Biology; C. W. Greene, Biology; J. G. Hardy, Mathematics; W. A. Jones, Chemistry; C. E. Mendenhall, Physics; S. A. Mitchell, Astronomy; J. L. Nichols, Pathology; E. E. Reid, Chemistry, C. W. Waidner, Physics. It appears that these awards represent four notable instances of heredity either of 'nature' or of 'nurture.'

THE White professorship of moral philosophy at Oxford, vacant by the death of the late Professor Wallace, has been filled by the selection of Mr. John Alexander Stewart, tutor of Christchurch, and known as the editor of Aristotle's *Ethics*.

THE allowance made from the public funds for the English University Colleges and for the College at Dundee has this year been increased from £15,000 to £25,000. On the recommendation of a committee, consisting of Mr. T. H. Warren, President of Magdalen College, Oxford, and Mr. G. D. Liveing, professor of chemistry, Cambridge, the apportionment has been made as follows:

The Owens College, Manchester......	£3,500
University College, London............	3,000
University College, Liverpool.........	3,000
Mason College, Birmingham...........	2,700
King's College, London................	2,200
Yorkshire College, Leeds...............	2,200
Durham College of Science.............	2,200
University College, Nottingham......	1,500

Firth College, Sheffield..................	1,300
University College, Bristol.............	1,200
Bedford College, London..............	1,200
University College, Dundee...........	1,000

DISCUSSION AND CORRESPONDENCE.

A PLEA FOR 'SCIENT.'

TO THE EDITOR OF SCIENCE: I wish to ask you not to use 'Scientist' in the pages of SCIENCE any longer, but to employ in its place the term 'Scient,' which is already well known in English in such compounds as 'omniscient' and 'prescient.' 'Scientist' appears to have been formed from 'Science' after the fashion of Artist from Art, but the 't' is an unfortunate intruder, and the better derivative would have been 'Sciencist.' But 'Scient' is shorter and much more correct. Moreover, it is the exact equivalent of the French term 'Savant,' which is frequently used in English also, but generally in a more or less derisive sense. Therefore, let us in future say 'Scient' (= 'sciens,' a man that knows) to which there is no possible objection, and which is already in frequent use in composition.

T. L. SCLATER.

ZOOLOGICAL SOCIETY OF LONDON,
June 23.

[It is easier to name a hundred species than to give currency to one obsolete word. The word 'Scientist' was introduced by the late Dr. B. A. Gould. It is not used in editorial contributions to this JOURNAL, but being a useful word, correctly formed (from *scientia; cf.*, scientific), it bids fair to outlive its ugly associations, perhaps more quickly in Great Britain than in the United States.—ED. SCIENCE.]

SHARPENING MICROTOME KNIVES.

SINCE Professor Minot has brought into prominent notice* Moll's method of sharpening microtome knives, it might be of interest to call attention to the fact that in an earlier paper† Moll describes a very useful part of the method which is not mentioned in the article cited by Professor Minot. It consists simply in the use of emery and water on plate glass to grind the knife into shape and to renew the edge when it has been injured in any way. After trying numerous abrasives, including the particular grades of emery used by Moll, I discovered that carborundum is by far the best for this purpose. It is so extremely hard and is supplied in such uniform grades* that it is possible after the knife has once been ground to shape to grind out a bad nick in a few minutes, which greatly minimizes the annoyances of cutting resistant tissues. After the edge has been smoothed as much as possible with the finest grade of carborundum, diamantine † is used as Professor Minot describes. Moll recommends using one side of the plate for grinding and the other for polishing the edge. To grind into shape the edge of a knife or razor as furnished by the manufacturer is a matter of considerable difficulty, and here in particular carborundum or emery is almost indispensable. Those possessing microtomes in which razors can be clamped will probably find it more convenient to obtain thick razors already ground to shape and with the superfluous part of the cutting edge removed, as advocated by Moll. Such razors, of good English manufacture, slightly hollow-ground, and having a cutting edge measuring about 14–16°, are sold by P. J. Kipp & Zonen, Delft, Holland, for $2.50. (A glass plate mounted on a wooden block for sharpening the same can be had for $1.25.) These razors are rigid, in this respect very different from the thin, very hollow-ground ones usually found on the market. They have an advantage over knives in being more easily handled, besides being cheaper and easier to protect from injury when not in use.

WALTER T. SWINGLE.

U. S. DEPARTMENT OF AGRICULTURE.

* SCIENCE, N. S. 5, No. 127, June 4, 1897. Pp. 865–866.

† Moll, J. W., Het slijpen van microtoom-nessem, Botanisch Jaarboek uitg. door het Kruidundig Genootschap Dodonaea te Gent. 3, 1891, 541–554. Pl. 15; with a French résumé, pp. 554–556. (Gent, J. Vuylsteke.)

* I have used the No. 2 Carborundum of the 'sizes' 220, 1 minute, 5 minutes and 10 minutes, supplied by the Carborundum Company, Monongahela City, Pa.

† No. 1 pour franchir of A. Guyot-Lupold, Locle, Switzerland.

SCIENTIFIC LITERATURE.

The Ancient Volcanoes of Great Britain. By SIR ARCHIBALD GEIKIE. London, Macmillan & Co., Limited. New York, The Macmillan Company. 1897. 2 vols., Imperial 8vo, with seven maps and many illustrations.

The title of this work is hardly commensurate with the scope of its subject-matter. Since the author's characteristic modesty has restrained him from giving it a name adequately expressing its magnitude and importance, he may kindly permit his readers to name it for him in full and call it more justly: A treatise on vulcanology exemplified chiefly by the ancient volcanoes of Great Britain. Such a treatise is needed. The time is come when the cumulative gains of our knowledge of volcanoes acquired during the last twenty years should be reckoned up and an account of stock taken, when bad assets should be sponged out and doubtful ones appraised at reasonable estimates. Nearly every branch of science needs a periodic overhauling and a revised statement of its general facts and principles in the light of its most recent advances. It is long since volcanic geology has had a satisfactory one. But it has one now at the hands of a master. The method of treatment, the logical order of the constituent parts, the arrangement of its wealth of material, are such as to enable the reader to see, as clearly as the present state of the science permits, the relations of parts to the whole and of facts to principles. The broader generalizations which have thus far been reached concerning the nature of volcanic action, its products and their modes of occurrence, are first stated. They are put forward briefly and conservatively, and no words are wasted in needless discussion. This presentation of the subject of vulcanism in general is the object of the first seven chapters, or Book I. The remainder of the work is a detailed discussion of the volcanic phenomena of the British Islands. The arrangement or plan of this discussion is doubtless the best one that could be selected. It begins with the most ancient, advances through the succeeding geological ages in their regular order, and ends with the most recent. The broader and more general facts laid down in Book I. are the guiding principles of this discussion, and the vast array of concrete facts becomes the foundation upon which the principles and generalizations repose. It will be interesting to glance, necessarily in the briefest manner, at the special points of interest in this work.

The first chapter is in the nature of a prelude or exordium preparatory for what is to follow. It points out what geologists of other countries might otherwise fail to realize, that the British Islands have peculiar advantages for this study because of the remarkable completeness of the geological record, the exceptionally full development of volcanic activity in nearly all geological ages, and the advantageous manner in which its results are exposed to view by denudation. American geologists may find difficulty at first in realizing this, but the author makes it certain. And so this little island, which would be buried half a mile deep in a fraction of the lava which swamps our northwestern States, proves to be as fruitful in material for the edification of vulcanology as it has been for the advancement of civil liberty and civilization. In the work at large we find such a wide range and variety of volcanic phenomena that the rest of the world is not likely to furnish many that are much more valuable, or that would materially affect the inductions drawn from those of Britain, though other regions may furnish occurrences which seem to be absent there.

The second chapter speaks of the causes of volcanic action. It is, therefore, a very short one, for alas! how little we know of those causes. Just here we are fortunately not concerned with the discussion of them, but merely with the way in which the author treats them. He says just enough to indicate his acquiescence in the contractional hypothesis, of which the extrusion of molten magmas within the earth is regarded as a concomitant. Conjoined with this is the intense elastic or explosive force of the vapors occluded in those magmas and which we see escaping from them during the act of eruption. The causes of volcanic action constitute the darkest and most discouraging problem in physical geology, with the exception of the causes of regional elevations, which may perhaps be only another phase of the same mystery.

To a wise and prudent man no chapter could be more embarrassing and disagreeable to write than this one. In truth, the science has no newly established inductions to record which help to solve this mystery. It is just where it stood twenty years ago.

But if the second chapter is unsatisfactory by reason of the obduracy of the subject and the lack of progress to announce, the third and fourth chapters are the reverse. In these are described the materials brought by eruptions to the surface and their modes of occurrence. Along this line there has been great and rapid progress and our knowledge is fast taking shape. Since the time of Sorby the petrographer's microscope has yielded a world of knowledge of the constitution of rocks and opened the way to the solution of many questions. The field observation of erruptive material has also become more accurate and discriminating. The author's treatment of the whole subject, though brief and much condensed, is admirable. The field geologist of long experience among the volcanics will keenly realize the practical and accurate way in which every important feature is described and its significance interpreted. As we read it, it all seems simple enough. But it is that simplicity which is the result of great knowledge and experience, clarified by many years of laborious thought and frequently revised expression of it in writing. Especially gratifying is the broader or primary basis of his classification of the lavas. It is the strictly chemical one and there should be no other. In fact, most geologists have now adopted it by common consent. The classification by contained minerals and texture can only be secondary and subsidiary. In the earlier stages of microscopic petrography there was an apparent tendency on the part of many able investigators to make everything turn upon mineral contents and it proved to be a serious clog upon the results of their researches. New facts in extraordinary abundance, and many of them of high import, were brought to light, but the methods of grouping them often selected rendered them barren of generalizations. It is a matter of vast importance how we group volcanic rocks, for it profoundly influences the directions and limitations of our speculations concerning their genesis and primitive condition within the earth. The descriptions of the rock textures, their appearance to the naked eye and in the microscope, and the explanations of the terms which are commonly used to designate their many varieties, are all excellent and the examples well chosen. The descriptions of lava sheets follow. The clastic volcanic materials, conglomerates, agglomerates, tuffs and volcanic dust are given careful and accurate attention. The finer material is worthy of especial study in this country, where it has not hitherto been followed up with the diligence it deserves.

The fourth chapter is devoted to the especial consideration of materials errupted at the surface and to the types of volcanic piles, three types being taken, the Vesuvian, the Plateau or fissure and the Puy types.

The fifth chapter deals with the underground phenomena, the vents themselves and the necks or cores left in the passageways of the lavas to the surface being described with great fullness. It is a favorite theme of the author and he invests it with the liveliest interest.

The next, or sixth, chapter treats of dykes and the subterranean intrusive masses in the forms of laccolites and sheets of lava forced in between sedimentary beds. Finally he discusses those remarkable and singularly interesting intrusions named bosses, which are often so puzzling and hard to understand and which look as if a vast mass of relatively soft or plastic material had been trying to punch an immense hole or passageway upwards through hard, rocky strata and at the same time to preserve its identity and general shape with comparatively little deformation. This paradox is often seen in our Western mountains and is the problem of the so-called dome structure and eruptive granite of California and Colorado.

The remainder of the work, and much the greater part of its bulk, is a detailed description of the volcanic relics of the British Islands. It begins with the eruptions of the Archæan and ends with those of the Tertiary. The whole mass of material is arranged so as to constitute a geological history of vulcanism and also so as to show it in its relations to the geological evolution of the land. It is not light reading and is not a study for children. But to the ex-

perienced it is of profound interest from beginning to end. Each geological age is made a chapter, or series of chapters, by itself and is prefaced with a short, clear exposition of the general geology of that age as represented in the British formations, thus preparing the way to the easiest understanding of the relations of the volcanics to the geology at large. The first one will be of deep interest to all geologists, and to many it will be the most fascinating. For it treats of the pre-Cambrian rocks and the mystery of the 'fundamental complex.' In a few paragraphs he sketches in outline the state of knowledge of the rocks which underlie the oldest known sediments of Britain. Here, at the uttermost bounds of geological knowledge and in the dim light of the earliest known order of things, we find remnants of volcanic action. The admirable studies of Teall among the Lewisian or 'fundamental' gneisses of Murchison, exposed in the northwest of Scotland and in the Hebrides, leave little doubt that the great bulk of them are plutonic igneous rocks. They differ in no essential respect from those deeply buried bosses or intrusions of later ages which are known to be connected with surface eruptions and constitute the subterranean portions of the outflowing masses. But beds clearly contemporaneous and erupted at the surface have nowhere been identified, and interbedded clastic volcanic formations are also absent. On the other hand, the Archæan complex is traversed by innumerable dykes, which are certainly older than the oldest rocks which overlie the complex, and their volcanic nature is unmistakable. It is interesting to compare this with the conclusions reached by American geologists in the 'basement complex' of Canada and Lake Superior, where the facts are of the same nature and the conclusions are the same, except that surface eruptions both massive and clastic are recognized in abundance.

Sir Archibald still retains the name 'Lewisian gneiss' as originally given by Murchison. Why have our geologists been so shy of the good old name, Laurentian, given by Logan? Certainly a rose by any other name will smell as sweet, but what is the use of the other name? The extreme caution and candor of Irving (R. S.) were lovable, but they did not call for a new one. The old one would have misled nobody unless the true spirit of geology were not in him. All needful reservations geologists will make for themselves.

In the same chapter the reader is carried up into the vast pre-Cambrian formations which overlie the Lewisian, from which they are divided by the great unconformity, probably the greatest in all geological time, and to the first great series the name of Torridon sandstones is given. They abound in dykes, intrusive sheets (or 'sills') and bosses, but no surface eruptions have been proven. Higher still after another great unconformity is a vast succession of crystalline schists (provisionally named Dalradian) whose age is not yet determined, but which seem in part at least to be pre-Cambrian. They too abound in eruptives and their general character suggests our own Algonkian rocks. It is obviously impossible here to note in detail the substance of the long series of chapters which carry the reader from the Archæan to the close of the Palæozoic. Only the most general summary can be given. And yet to pass thus cursorily over the many chapters relating to the eruptive masses of the Cambrian, the Silurian, the Old Red Sandstone, and, above all, the long series of chapters devoted to the Carboniferous, with all their wealth of material wrought out in such a masterly way, seems unappreciative. We are presented with an immensely long vista of volcanic action, beginning with the earliest epoch of which we have any knowledge and extending down to the close of the Palæozoic, manifesting itself in all that succession of ages. But the more ancient they are the more profoundly have the erupted materials been changed or modified by metamorphic action and disturbed by repeated earth movements with dislocations and distortions of the strata, so that the determination of their true volcanic nature has required many years of labor by hundreds of earnest workers in the field and laboratory and with the microscope. The result of this labor now seems well assured, not only in Britian, but in all other countries where geologic research is diligently prosecuted. One grand result of it is the conclusion that volcanic action has been the same in all ages. And when our thoughts reach

back to the Archæan we find that even then the world was an old world. Nor are there any visible signs that the world was then any nearer the beginning than it is to-day. Geology has thus far found nothing to tell us about the beginning of mundane things, and our notions of a primordial state of the world must come wholly from outside the domain of geology.

With the close of the palæozoic came a long age of quiescence in volcanic action. No traces of it have been discovered in any part of the Mesozoic of Britain, and only trifling ones in the Mesozoic of all Europe. But though the fact is a wide one, it is not world-wide. The eruptive masses of our own Appalachians, New England and Nova Scotia are Jura-Trias, and the vast fields of the Deccan in India are assigned to the Cretaceous. That they should have slumbered so long in Europe is remarkable, but still more so is the fact that their fires should have been awakened again with full energy in the Cenozoic and often in the same old places.

The description of the Tertiary eruptions of Britain is the theme of the greater part of the second volume. It is of especial interest to American geologists whose labors have been most largely in the far West, where the main eruptive masses are distributed all the way from early Eocene down to a time which is surely post-Glacial. The chapters on these rocks are a veritable mine of information. Remarkable indeed are the two chapters on the Tertiary dykes not only on account of the extraordinary development of these features in the island of Great Britain, but equally so on account of the thorough manner in which they have been worked up in the field and in the laboratory. Of course, it represents the labor of many investigators for several generations, but among them we know that our author is preeminent. He draws an interesting inference from them. While accepting the physicist's view of the general solidity of the earth as a whole, he concludes that during the Tertiary volcanic period not less than 40,000 square miles of Britain were underlaid by one or more reservoirs of liquid lava. This state of affairs he puts into relation with a discussion as a pure mechanical problem by Hopkins, in 1835, where just such conditions were assumed. The inferred result was the formation of fissures similar in form and grouping to those which field observation discloses.

The chapters on basaltic plateaus constitute the most conspicuous subject connected with the Tertiary eruptions. Assuredly the grandest results of volcanic action the world over are the plateau eruptions. Great piles like Shasta and Ætna, however imposing, are after all secondary in importance. The plateau eruptions of Great Britain, their extension into the far North to the Faroe Islands, and their possible connection with those of Iceland, are a grand theme and the descriptions of them are worthy of the subject. In the author's mind these plateau eruptions often take the form of the so-called fissure type as distinguished from the centralized vent, and the dykes as described in preceding chapters are regarded as the relics of fissures supplying the lavas of plateaus which have been swept away by secular erosion. In view of the great importance attached to the massive eruptions from fissures he introduces an interesting sketch of the lava fields of Iceland, which are believed to furnish the most impressive examples of recent occurrence.

American geologists will take a lively interest in the chapters which follow, describing the intrusive Tertiary rocks, especially the olivin-gabbros and the eruptive granites. We have them in this country and they have awakened warm discussions as to their real nature. Their true eruptive character is now beyond dispute, and their occurrence in Tertiary time is an important consideration in establishing the practical identity of volcanic action in the most ancient and most recent ages. The British examples are certainly admirable ones and are described with the author's usual precision and clearness.

It seems like trifling with a serious subject to merely notice in this fragmentary way a few points in this great work, which abounds in an unspeakable wealth of instructive and interesting material, all wrought out and delineated with a master hand. The arrangement is admirable. Everything is in logical order, and whatever precedes is a preparation for that which follows. The broad plan of the work is historic progression, and as we complete the

perusal we can look back through 'the corridors of time' and admire the perspective with everything in due proportion.

I regard this monograph as the greatest work on vulcanology ever written. Scrope's work on the volcanoes of central France was indeed a great one—almost an epoch-making one in its day. Nor is its force or usefulness yet spent. For it may be still read with great profit and instruction. But it was much more limited in its categories and discoursed upon the volcanoes of a single period. The work before us deals with vulcanism in all its aspects and with volcanoes of all time, and embraces a vast accumulation of knowledge, of which the world in Scrope's time knew little or nothing.

C. E. DUTTON.

Catalogus Mammalium tam viventium quam fossilium. By DR. E. L. TROUESSART. Berlin, R. Friedländer & Sohn. January, 1897. 2d ed., fascic. I., Primates, Prosimiæ, Chiroptera, Insectivora. 8°, pp. 218.

The appearance of the first part of the new edition of Trouessart's 'Catalogue of Mammals, Living and Fossil,' will be welcomed by all students of mammals, for such compilations, in spite of their inherent imperfections, are a great practical convenience.

The present part contains 265 genera and 1,294 species, which numbers, contrasted with those of the first edition (1878–81), show a falling-off of 104 genera and an increase of 200 species. The decrease in genera seems to be due in the main to different limits assigned to the orders, chiefly from the shifting of fossil genera.

The work is apparently brought down to the end of 1896, as it includes *Nesopithecus* Forsyth Major (published in October, 1896) and recent species described by Thomas. For fossil forms Rogers's 'Verzeichniss' and Lydekker's 'Geographical History of Mammals' have been consulted. Five new generic and subgeneric names are proposed, as follows:

p. 17. *Rhinostictus*, based on Sclater's *Cercopitheci rhinosticti* 1893.

p. 19. *Erythrocebus*, based on Sclater's *C. erythronoti*.

p. 22. *Otopithecus*, based on Sclater's *C. auriculati*.

p. 68. *Prosinopa* for *Sinopa eximia*.

p. 204. *Scaptogale* for *Echinogale* Pomel 1848, preoccupied.

The usual sequence of forms is reversed, the Catalogue opening with the genus *Homo*, which, by the way, is given independent ordinal value ('Ordo I. Bimana') in accordance with the antiquated Cuvierian system. *Pithecanthropus* is recognized as a valid genus—the highest anthropoid—and is the first genus given under Primates. The Lemurs are raised to ordinal rank. The classification adopted is in the main that of Flower and Lydekker (except that it begins at the wrong end), but we regret to see that Lydekker's excellent division of the old order Edentata into *Edentata* (Armadillos, Anteaters and Sloths) and *Effodientia* (Pangolins and Aard-varks) is not followed.

The matter is so arranged that the specific names, references and synonymy form a broad column on the left-hand side of the page, while the geographic distribution occupies a narrower column on the right. Unfortunately, the type localities are not given at all. The specific names are numbered consecutively and are printed in black-face type; the subspecific names are not numbered and are in italics. 'Varieties' are preceded by '*Var.*' but the author neglects to state how he imagines a 'variety' to differ from a subspecies. Synonyms are indistinguishable from the recognized subspecies, except that they lack the letter and dash [a.—] which precede the former—a hardly sufficient distinction.

By this method of treatment the distinction between species and subspecies is greatly exaggerated—a common error among authors whose knowledge of the forms treated is derived mainly from books rather than from specimens. Whether the describer of a new form accords it specific or subspecific rank depends, according to present usage, on his belief as to the existence or non-existence of intergrades connecting it with other forms, and his views on this subject are pretty sure to vary with the material at hand and the time spent in its study, and sometimes with his mood and the particular day his manuscript goes to press. Hence it is not surprising that an author often changes his attitude with respect to the status

of a particular form, treating it as a subspecies in one paper and a full species in the next. In the case of the Texas mole described as a subspecies by Dr. J. A. Allen in 1891 and raised to specific rank by the same author in 1893, Dr. Trouessart adopts a curious course. He gives it as a full species with 189*3* as the date, and then in synonymy gives the subspecific form in which it was originally described, with 189*1* as the date, showing that he was aware of the correct date. Of course, the species should date from 1891—the year in which *the animal* was named—for the date on which an author happens to change his mind as to the *rank* of a particular form has nothing to do with the date of the name. If this case represents Dr. Trouessart's views in this matter the inference is that he, like some botanists of the old school, is a worshipper of the 'combination.' He certainly agrees with these botanists in spelling personal and some other specific names with a capital initial letter—in this respect again departing from the best usage among zoologists.

Sections of genera and forms of species of earlier authors are sometimes given formal subgeneric and subspecific names, and names so given are credited to the early author instead of to himself. Thus the section 'Cercopitheci Rhinosticti' of Sclater is made the subgenus '*Rhinostictus* Sclater,' and Dr. Harrison Allen's 'Var. (b) Northern form of Vespertilio gryphus' is made 'Var. *septentrionalis* H. Allen.'

I am indebted to Dr. T. S. Palmer for calling my attention to Dr. Trouessart's extraordinary rule for the treatment of preoccupied names. If he finds such names preoccupied among mammals he promptly renames them (as *Scaptogale* nob. for *Echinogale* Pomel), but if they are preoccupied in other branches of the animal kingdom he lets them stand. Thus the generic names *Tylostoma* (p. 155), *Schizostoma* (154), *Macrotus* (152), *Mystacina* (149), *Furia* (135), *Vesperus* (106), *Megaloglossus* (98) and many others are retained, notwithstanding the fact that all are preoccupied and replaced by other names now in more or less common use. A few of the dates given for genera are erroneous. For instance, *Leuconoe* Boie '1825' should be 1830, and *Dendrogale* Gray '1843' should be 1848. *Prototalpa* is evidently an amended form of *Protalpa* and as such should date from *Prototalpa* Roger 1887 instead of *Protalpa* Filhol 1877.

Since the appearance of the first edition of Dr. Trouessart's Catalogue (1878–85) no attempt has been made to collect in one work the names of all the mammals of the world; and since all fossil as well as living species are included, the immensity of the task is apparent. Most authors shrink from such an undertaking, not only on account of its magnitude, but also on account of the extreme difficulty, not to say impossibility, of determining the status of described forms in groups that have not been recently revised. Nevertheless the work is of such great practical utility that for years to come every student of living or fossil mammals must keep a copy at his elbow and will owe its author a debt of gratitude. Dr. Trouessart is evidently a very rapid worker; we wish him health and freedom from interruptions, so that his great undertaking may be speedily completed.

C. H. M.

SOCIETIES AND ACADEMIES.

THE 96TH REGULAR MEETING OF THE CHEMICAL SOCIETY OF WASHINGTON.

THE following program was presented:

H. N. Stokes: 'The Chloronitrides of Phosphorus.' P. Fireman: 'The Ripening of Cheese and the Rôle which Micro-organisms Play in the Process.' E. A. de Schweinitz and Marion Dorset: 'The Product of the Tuberculosis Bacillus.' H. W. Wiley and W. H. Krug: 'The Standard Methods of Starch Determination.' W. H. Krug and J. E. Blomén: 'The Commercial Preparation of Nitro-napthalene.' F. K. Cameron: 'The Replacement of Chlorine by Sulphur in Alkaline Chlorides.' Wirt Tassin: 'A New Mineral.'

Dr. Stokes showed that the only members of the phosphorus Chloronitrides series $(PNCl_2)_n$, hitherto known are $(PNCl_2)_3$ (Liebig) and $(PNCl_2)_4$ (Stokes). The series is now extended to include $(PNCl_2)_5$, $(PNCl_2)_6$ and $(PNCl_2)_7$, as well as a mixture of higher polymers, not yet isolated, and terminating with a rubber-like polymer of high molecular weight. The substances are prepared by heating equimolecular weights of phosphorus pentachloried

and ammonium chloride in sealed tubes, whereby a mixture of chlorides in nearly theoretical amount is obtained. This is distilled from the open tube and afterwards submitted to careful fractional distillation *in vacuo*. The unique feature of the series is found in the fact that any member can be converted into the rubber-like polymer by heating, and that the latter, on distilling at a higher temperature, breaks down quantitatively into a mixture of all the lower members; it is, therefore, possible ultimately to convert any member completely into any other by heating and distilling alone. The lower members, up to and including $(PNCl_2)_6$ are well characterized, finely crystallized bodies, while $(PNCl_2)_7$ is liquid. Their stability diminishes with increasing molecular weight, $(PNCl_2)_3$ being unattached by boiling alkalies, while the rubber-like polymer is destroyed by boiling water. The formation of $PNCl_2$ and $(PNCl_2)_2$ could not be detected. The chloronitrides constitute the first extended series of inorganic polymers interconvertible by simple and direct means.

Dr. Fireman gave an extended résumé of the work of Duclaux and others showing that the lactic acid producing bacteria are not so important in the production of butter flavors as are the peptonizing bacteria.

Drs. de Schweinitz and Dorset stated that in studying the products of the growth of the tuberculosis bacilli in artificial media, it was noted that the reaction of the cultures usually becomes acid, and as Prudden and Hodenpyl had succeeded in producing tuberculous nodules without necrosis by the intravenous injection of dead bacilli, it seemed as though it should be possible to isolate from cultures of tuberculosis bacilli an acid substance, which is responsible for the necrosis of tissue that always takes place in this disease. After many fruitless attempts they succeeded in isolating from artificial cultures a crystalline acid substance having a melting point of 161° to 164° C. which was soluble in ether, alcohol and water, and crystallized in needle-like prisms. The solution of this substance was optically inactive and did not give the biuret action. The preliminary analysis of this substance gave a formula, like that of teraconic acid and the other properties correspond closely with this acid. Its identity if such has not yet been proved. When injected subcutaneously into guinea pigs it causes a slight inflammation and localized necrosis, and injected directly into the liver tissue by means of a hypodermic syringe it produces characteristic necrosis. The substance causes a reduction of temperature in tuberculous animals, and it seems probable that we have here the material which is responsible for the necrosis in tubercular infection.

Dr. Wiley and Mr. Krug showed that various methods depending on the polarization of the starch or its inversion products, as well as others based on direct weighing of the starch, were too inaccurate to commend themselves to the analyst. The only accurate methods depend on the eventual inversion of the starch into dextrose, which is then estimated by Allihn's method. Experiments in the preparation of the Nitro-naphthalenes showed that they can not be prepared from a-naphthalene sulphonic acid, but that the best yield is obtained with mixtures of nitric and sulphuric acids. The best results were obtained with 30° B. nitric acid, using about three times as much acid as naphthalene. The amount of sulphuric acid, used varies with the nitration degree desired, varying from 4 : 1 (nitric : sulphuric) for low melting products to 3:2 for the higher derivations.

Dr. Cameron cited some of his own experiments to show that, although it is possible in the case of some heavy metals to replace chlorine by sulphur by merely boiling the latter with a solution of the chloride, it is impossible to obtain such a reaction with alkaline, or alkaline earth chlorides even upon heating in sealed tubes at a high temperature.

Mr. Tassin gave a short description of a new mineral, but reserves the details for special publication.

V. K. CHESNUT.
Secretary.

TORREY BOTANICAL CLUB, MAY 26, 1897.

THE President, Hon. Addison Brown, presided. The evening was devoted to a lecture by Mrs. Elizabeth G. Britton, entitled 'The

Moss Flora of the Adirondack Mountains,' illustrated by lantern-slides prepared by Mr. C. H. Van Brunt, and also by numerous mounted specimens. These specimens, comprising about 150 sheets, handsomely displayed about the walls of the lecture-room, represented collections made by Mrs. Britton in the vicinity of Adirondack Lodge and Lake Placid in the years 1892, 1894 and 1896. The various locations where these mosses grew were described, including the story of a climb up Mount Whiteface. Graphic bits of description of these mosses brought out salient points as the slides indicating their structure were exhibited, and these were accompanied by numerous slides illustrating the scenery of their habitat. Among about 30 rare species enumerated were *Raphidostegium Jamesii*, not previously reported for New York State, and *Bryum concinnatum*, found only once before in the United States. Duplicates of Mrs. Britton's collection have been deposited at the State Herbarium at Albany, the main collection having been presented to the Herbarium of Columbia University. Partial sets were sent to the Brooklyn Institute, to Cornell University and to various other collections.

The subject of the lecture was further discussed by Mr. A. P. Grout and by Mrs. Britton, after whieh the Club adjourned to the second Tuesday in October, field meetings continuing meantime on Saturdays.

EDWARD S. BURGESS,
Secretary.

SCIENCE CLUB OF THE UNIVERSITY OF WISCONSIN.

MR. EDWARD KREMER discussed 'The Periodic System.' The speaker introduced his subject by giving a brief account of the earlier attempts to refer back to a prime matter the manifold forms in which material nature reveals herself to man. This line of thought was briefly traced from the early Greek philosophers to Prout. The reaction that followed Prout's hypothesis was duly emphasized. The lack of interest in Doehereiner's trials, and the modifications of these trials by others, in Newland's octaves, in Lothar Meyer's first chart it was thus explained in large part. Attention was also called to the fact that the principal interests seemed to center about the numerical relation existing between the atomic weights of the elements and that the time value of the system was not duly appreciated until this was made secondary to the natural classification of the elements according to their physical and chemical properties. Incidentally the prediction by Mardelejiff of the existence of certain elements and their discovery by others were alluded to, because with the discovery of their elements the natural law gained more general favor. What the periodic law really is was strongly emphasized, also the fact that the present arrangement of the elements according to this law is imperfect, but more recent systems were not discussed, partly for want of time. Finally the great advantage to be gained by using the periodic law as the basis for teaching advanced chemistry was demonstrated

C. S. SLICHTER reviewed Larmor's 'Theory of the Ether.' He first gave an explanation of the vortex theory of matter, including the properties of vortex rings and their mode of linking, and kinds of vibration. Hill's spherical vortex was explained by a diagram, and the possibility of building up a rotationally elastic ether from such cells was explained. Photographs of sandstone showing turbulent motion were presented for the purpose of showing the character of their structure. The intrinsic energy of the ether, radiation, action at a distance, density and inertia of common matter were then discussed, closing with a new theory of gravitation. Mr. Quantz gave the results of work on the psychology of rapid reading. They were the results of a statistical study of the mental habits and characteristics of fifty university students, showing that rapidity of reading depends chiefly upon the following factors, given in the order of their importance: (*a*) quickness of visual perception; (*b*) practice, as measured by extent of reading from childhood up; (*c*) power of mental concentration; (*d*) absence of motor-mindedness (lip movement in silent reading); (*e*) rapidity of mental operations in general; (*f*) strongly developed eye-mindedness; (*g*) scholarly ability, as determined by class study.

WM. S. MARSHALL,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis on the 7th of June, 1897, twenty-one persons present, Mr. Robert Combs, of Ames, Iowa, presented a paper entitled 'Plants Collected in the District of Cienfuegos, Province of Santa Clara, Cuba, in 1895-1896.' The paper embraces the results of a collection extending from the commencement of the rainy season of one year until the close of the dry season the following spring, the territory covered by the collection lying between the entrance of the Bay of Cienfuegos, on the south coast of Cuba, up the bay and the river Damuji to Rodas, and extending back from the river to Yaguaramos and almost to the Cienega de Zapato, a region including nearly all kinds of soil and conditions found upon the island, except those of the mountain regions and the mud swamps. A brief statement was made concerning the origin of the Cuban flora and its affinities with that of continental Central America, rather than the geographically nearer Floridan region.

The paper comprised a full catalogue of the collections made, which had been determined at the herbarium of Harvard University, and of which several sets had been distributed to the larger herbaria.

Professor F. E. Nipher made some remarks on the difficulties yet involved in the theories of the ether.

WILLIAM TRELEASE.

THE TEXAS ACADEMY OF SCIENCE.

AT the annual meeting of the Texas Academy of Science, held in the chemical lecture room of the University of Texas, June 15th, the following papers were presented:

'The Personality of a Great Genius—Sylvester,' by Dr. George Bruce Halstead, in which the author took occasion to point out the exalted position of the higher pure mathematics and to give his estimate of Sylvester—his old friend and teacher—as a mathematician.

'Epsom Salts, Magnesium Sulphate, from Brown county, Texas,' by Dr. H. W. Harper. The occurrence of Epsomite in large quantities in Brown county, and of a purity sufficient to make it the source of an exceedingly cheap commercial product, was here announced for the first time. Dr. Harper's analyses gave the following results:

Water	40.07	40.00
Silica	21.075	21.43
Alumina and Iron Oxides	2.20	2.21
Magnesium Oxide	12.381	12.38
Calcium Oxide	trace.	
Sulphur Trioxide	24.014	24.01
	99.74	100.03

Calculated to contain 76.13 % $MgSO_4.7\ H_2O$.

A series of experiments demonstrated that the crude material yields crystallized $MgSO_4$ within one or two % of the analyticai results.

'Some Texas Oil Horizons,' by Hon. E. T. Dumble. The Oil Horizons in Texas range from the Carboniferous to recent formations. I. The lowest horizon in the State is in the Bend division of the Carboniferous—the black shales of the Colorado river near Brownwood. They are apparently a continuation of the asphalt deposits of Indian Territory, as indicated by the finding of similar fossils. II. The lower beds of the Cretaceous—the Trinity Sands—in Jack, Montague and Burnett counties. III. The Eagle Ford Shale (Benton) of the Cretaceous, as, for example, in the well at Fiskeville, which furnished a little oil, and in the railroad cut south of Austin, where, it is said, the shale will burn. IV. The Black Marls of the Black Waxy Prairie Division of the Cretaceous. The well at Corsicana encounters at 1,040 feet a 15-foot oil sand. Oil will also be found eastward to Smith and Anderson counties. V. The Nacogdoches horizon, which seems to be the eastern appearance of the oil and asphalt deposits of California.

'Pedagogical Note on Mensuration,' by Professor Arthur Lefevre.

'The Texas Permian,' by W. F. Cummins (read by title).

'On the Bio-Geography of Mexico and the Southwestern United States,' by C. H. Tyler Townsend (read by title).

The following officers were elected for the ensuing year: President, Dr. George Bruce Halsted: Vice-President, Professor T. U. Taylor; Treasurer, Hon. E. T. Dumble; Secretary, Professor W. W. Norman.

FREDERIC W. SIMONDS.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, JULY 16, 1897.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*ON THE THEORY OF ORGANIC VARIATION.**

As the evolution question becomes more and more deeply examined the particular phenomena described under the terms variation and heredity are concentrating much closer observation and thought. The whole philosophy of the matter seems to turn upon the interpretation of these phenomena.

* An address delivered before the Philosophical Club of Yale College, April 1, 1897.

In this discussion biologists and those who are engaged in adjusting biological theories to the systems of human thought appear to be resting on the assumption that the great result of the speculations of the last fifty years has been the furnishing of a rational explanation of the so-called natural causes of variation of organisms in their morphological and physiological aspects. This assumption appears to be associated with another, which in some sense is its antithesis, *i. e.*, that those organic phenomena which recur in relatively uniform cycles in successive generations of organisms are fundamental, are the expressions of the intrinsic nature of organic matter, and thus lie beyond the immediate investigation of science. According to this view, heredity (*a*) is not caused, but is a primary law of all organisms; variation (*b*) is a departure from the strict operation of the law of recurrence in generation; and thus external environment (*c*), or the general conditions of being in which organisms exist, is effective in its interaction with the intrinsic energies of the organism in diverting or modifying the natural expression of those energies, to the causing of that diversity and heterogeneity of form and operation which we see about us. This is, as I understand it, a fair expression of the general attitude of thinking men toward the problem in question. This position has received little consideration because it has

been taken for granted as a fundamental truth. It may be tersely expressed in the following form:

1. Heredity is a fundamental law of all organisms.

2. Variation is an acquired law of organism, and is determined by the interaction of the heterogenous environment upon the otherwise uniformly operating organic matter.

It is the validity of these two propositions that I would call in question and discuss. Is heredity acquired? When the attempt is made to state with precision what takes place in the phenomena of organic evolution the question arises: What is the relation which variation bears to heredity as a factor in the case? Which is fundamental; which is acquired?

In order to make the real point of the case clear, let us take an analogy from the field of physics. In astronomical phenomena the planetary bodies are observed to be in rotary motion about the sun and about their own axes; is the rotary motion fundamental or acquired? The first law of Newton is this: "Every body continues in its state of rest, or of uniform motion in a straight line, except in so far as it is compelled by force to change that state." And force is defined as "whatever changes the state of rest or uniform motion of a body." According to these accepted laws of mechanics, rotary motion must be regarded as secondary to direct motion or translation. In order to explain rotary motion, the law of gravity is brought in, and the circular motion is defined as the resultant of the motion of translation adjusted to the gravitation of the masses of matter in motion.

From this analogy the real nature of the problem may be inferred when we ask what is the relation which heredity bears to variation in the field of biology? If it be a fundamental law of organisms to repeat themselves in cycles of generation, to adopt the analogy of mechanics and physics, it is essential to postulate some force to account for any deviation from such hereditary cycles. If, on the other hand, variation be the primary law of organism, the postulated force is required to account for the repetition: such a force would operate first in checking the variation. It will thus be seen that the explanation of the phenomena of life will be greatly modified according as one or other of these hypotheses be assumed to be true.

If we look back over the history of opinions in natural history we discover that a century ago the whole philosophy of organisms was dominated by the Cuvierian notion that species are immutable; *i. e.*, that the cycles of phenomena presented in the development of an individual organism in the passage from the embryo to the adult stages are the same for all members of a species; that this uniformity in expression of development by the individual is the mark or distinguishing characteristic of each species, and therefore that variations, or departures from this fixed law, are accidents due to the disturbing effects of outward environment upon the individual, and cannot be transmitted to offspring by the ordinary laws of heredity. It was this conception of the immutability of species which made 'special creation' of species seem to be a rational theory, and it was the calling in question of the immutability of species which was supposed to limit the capacity of creative force in the universe.

Lamarck advanced the theory that species are not fixed, but are mutable; and he was supposed to be attacking the very foundations of natural history; he was laughed at and his theory was, for the time, silenced by the weight of authority and the common opinion of naturalists. One of the strongest arguments used against his theory was the very fact of species as

they were then known to science. If they are mutable, it was argued, how would it be possible to separate so many which are known as perfectly distinct and not even capable of crossing so as to mix one with another. Sterility was seen to be an impassable barrier distinguishing one species from another, and, as the individuals of one generation are to be accounted for only as descendants of a previous one, how would it be possible to make this barrier on the theory that the law of each species is not fixed and immutable? But although the theory of mutability of species was thought to be absurd a century ago, and was supposed to contradict the fundamental principles of natural history, the idea of specific mutability has now become an established truth in our philosophy of organisms, and variability, or the power of the organism to *divert* from the current paths of development of its ancestors, has become the important factor in evolution. We find, in fact, Bateson, in his elaborate treatise on variation,* saying: "Variation whatever may be its cause, and however it may be limited, is the essential phenomenon of evolution; variation, in fact, is evolution" (p. 6).

When we follow up the history a step further we discover that the theory of mutability of species is built directly upon the Cuvierian philosophy, but it is by breaking down the distinction between varieties and species as originally understood. Lamarck and Darwin both accepted the old conception of the normal or fundamental uniformity of the processes of generation, but, recognizing the fact of departure from this uniformity, assumed that the variation is due to the active adjustment by the organism of its structure to changed conditions of environment (Lamarck); or, the variations being spontaneous or accidental, they are preserved and transmitted in generation from parent to off-spring (Darwin).

Both schools and, so far as I have observed, the great majority of all those who discuss these problems, have started with the assumption that the normal province of what is called by the general name of reproduction is the cyclical repetition of phenomena expressed in the ancestors, *i. e.*, that the phenomena will be alike unless some cause can be discovered for their dissimilarity. Hence to discover the cause of differences has been the chief purpose of observers and speculators.

Darwin's ideas regarding the nature of variability in organism are clearly set forth in his 'Origin of Species.' In the first chapter on 'Variation under Domestication,' under the general title 'Causes of Variability,' we find this significant sentence: "It seems pretty clear that organic beings must be exposed during several generations to the new conditions of life to cause any appreciable amount of variation, and that when the organization has once begun to vary it generally continues to vary for generations" (p. 14). A few sentences further on are these words: "It has been disputed at what period of life the causes of variability act," and "I am strongly inclined to suspect that the most frequent cause of variability may be attributed to the male and female reproductive elements having been affected prior to the act of conception," and again: "When any deviation of structure often appears, and we see it in the father and child, we cannot tell whether it may not be due to the same cause having acted on both" (p. 19). Again in the chapter on 'Laws of Variation:' "Nevertheless, we can, here and there, dimly catch a faint ray of light, and we may feel sure that there must be some cause for each deviation of structure, however slight"

*Materials for the study of variation treated with special regard to discontinuity in the origin of species, by Wm. Bateson. 1894.

(p. 121). And the closing sentence of this chapter: "Whatever the cause may be of each slight difference in the offspring from their parents, and a cause for each must exist, it is the steady accumulation, through natural selection, of such differences, when beneficial to the individual, that gives rise to all the more important modifications of structure by which the innumerable beings on the face of this earth are enabled to struggle with each other, and the best adapted to survive" (p. 153).

I quote thus freely from this standard author and classic treatise on evolution, in order that we may see what the assumption in the case actually is, and also to show that it is a fundamental assumption at the very foundation of the current philosophy of evolution. The quotations are sufficient to show that it was assumed that particular variations are particularly caused, *i. e.*, while variability may be regarded as the possibility of varying, or the latent capability to vary, each variety was, by Darwin, considered to be caused by a special something with which the organism comes into relation and which did not operate upon its ancestors.

I do not propose here to discuss the metaphysical question as to whether an organism may or may not be said to possess powers or potencies, properties or capabilities, or whether it is necessary or not to assume that an organism is capable of varying before it does vary. But in this paper attention is called to the relation which a certain class of biological phenomena bear to another class of biological phenomena, and, so far as it may be possible to confine one's attention to them, these phenomena alone will be considered. From this point of view variation is a deviation, in the order of sequence, of one series of phenomena from some other order of sequence with which it is compared. In the case of organisms the latter series of phenomena is that which the parent form (A) exhibits in the course of its growth from the ovum to maturity. The case we compare with it is the series of phenomena expressed by an offspring (B) in passing from the ovum to the mature stage. A variation occurs whenever, in any particular stage of the series, B varies or deviates from the series A. Supposing such a deviation to take place the morphological character (v) expressed in the structure of the organism (B) is often and may properly be called a variation. The whole organism B, with its added character (v), is often spoken of in biology as a variety of A, and all descendants of A exhibiting the variation (v) are said to be of this variety (Bv). As I understand the Darwinian doctrine (and I believe this is the generally accepted doctrine on this point) it is assumed that except for some special cause acting upon the organism A, or its ancestors for each particular variation (v) of this kind, there would appear no deviation in B, there would arise no variety Bv. Let us be careful not to raise the question whether the organism could vary or could not; the question is purely regarding the order of the phenomena. It is a question of science as to whether the variation takes place on account of some cause (I use the word used by Darwin and suppose we may infer that he means some interference with the course of phenomena taking place in the developing organism), and I raise the question: Have we any evidence to support the opinion that variations would not occur except for some such interference with the normal processes of development exhibited by the growing individual?

If we examine Professor Cope's 'Primary Factors of Organic Evolution,' standing, as it does, for the most extreme of the Neo-Lamarckian school of naturalists as contrasted with the Darwinian, we find a similar assumption on this point. Cope divides

his treatise into three parts, which he enentitles: I. The Nature of Variation; II. The Causes of Variation; III. The Inheritance of Variation. He begins the Part III. by saying that he proposes to cite "examples of the direct modifying effect of external influences on the character of individual animals and plants. These influences fall naturally into two classes, viz., the physico-chemical (molecular) and the mechanical (molar). The modifications so presented are supposed to be the result of the action of the causes in question, continued throughout geological time" (p. 225). A few of the examples cited are the conversion of *Artemia salina*, a salt-water Crustacean into a *Branchinecta*, a genus accustomed to fresh-water habits; the production of colors in Lepidopterous pupæ; light and feeding affecting the color of fish; the case of the blindness of cave animals; Dr. Dall's theory of the origin of plaits in the Gastropoda; the moulding the shape of the articulation of bones in accordance with the dominant strain put upon them; the mechanical origin of dental types in Vertebrates.

No question is here raised as to the reality of the observed phenomena; the association of particular modifications of organic structure with change in the conditions of environment to which the organisms are subjected is not disputed. But the specific question raised is this: Does environment in general, or do the external influences of a chemico-physical or mechanical nature (to use Cope's phrases), exert an influence over growing organisms to induce them *to depart from* the order of phenomena of their ancestors, or do these influences or forces produce the opposite effect of *controlling and limiting* variation? From the quotations it will be evident that the theory is clearly expressed in the writing of the two prominent schools of evolution of to-day that *these external influences do, either directly or indirectly, produce the variations.*

Several years ago my studies led me to doubt the validity of this view, and a careful study of the order of sequence shown in the succession of species in geological time has confirmed this opinion. My friend and former neighbor, Professor Bailey, of Cornell, a pupil and ardent disciple of Asa Gray, has been led to the same conclusion from the study of plants, and he has supported and given botanical evidence for the validity of the theory in this book on 'The survival of the unlike' (Macmillan, 1896, see p. 21, 22). I also presented some evidence of paleontological nature which seems to support the view ('Geological Biology,' 1894'). The present paper is intended to consider the philosophical line of reasoning upon which the theory rests.

The commonly held conception seems to be that variation, and consequently the essential essence of evolution, is some kind of modification of ordinary generation. So much is this true that in most minds and in standard treatises on evolution the two words development and evolution are used as synonymous terms.

We may then resolve the question into this concrete form: In the case of any particular organic cycles of phenomena, is it more simple and fundamental for the organism to reproduce its kind or to produce itself, *i. e.*, its mature self from the germ? We can logically find but one reply to this question. Production must precede reproduction. But what does this answer imply? It implies that the processes of development of the individual from the germ to the adult do, in their intrinsic nature, precede the phenomena of reproduction. It further implies that the phenomena of evolutional variation are supplementary to, and then a further pushing on of, the phenomena of individual development. The assumption, which is generally accepted, appears to be that this mode of variation is a modification of ordinary reproduction, either produced

by some spontaneous action of the organism, or the result of the influence of changing environment upon the organism. For, in speaking of variation, it is customary to say that the variation becomes fixed by selection, or becomes transmitted, as if the disturbance in the order of the phenomena, which at first entered as an accident, became, by some means, an added part of the normal cycle of development of succeeding generations.

We hear such expressions as that it is impossible that a variation can be transmitted till it affects the germ-plasm, or till the variation becomes a variation of the reproducing, as distinct from the somatic, part of the individual. This conveys the impression that that which varies is the reproductive cycle of phenomena, whereas the truth is more accurately expressed by saying that the reproduction cycle is augmented. The augmentation in the case consisting of an extension of the process of growth of the individual beyond the point reached by the ancestor, the process is, first, purely of the nature of the building up of tissue and structure, and is not reproduction, but simple production, the process of production going beyond the extent or limit reached by the ancestors.

The confusion arises from not distinguishing the phenomena by which the structure of the individual is perfected from other phenomena by which a new individual becomes separated from the old and begins, carries on and repeats the previous cycle of phenomena. That phenomenon which is the first step of every evolutional process, as well as every step by which evolutional progress is accomplished, is fundamentally a growth phenomenon, quite of the same nature as the growth taking place throughout the life of each individual. It differs from these normal growth phenomena only by exceeding in some particular, or deviating in some manner, from the cycle of growth phenomena of the ancestors. Evolution does not call for any augmentation of the phenomena of reproduction.

If we separate the processes of (1) the growth or development of one individual from (2) the reproduction of a separate second individual we discover that the development of the first individual must necessarily have been carried to a certain point of completion before the reproduction of a germ takes place, since it is the more or less mature individual which reproduces the germ. When, further, we compare with these two processes the further phenomenon of variation which results in evolution we find that the variation does not belong to the reproduction, but to the development of the individual. Variation is a transcending the course of development of its ancestor by the offspring ; reproduction of the variation is not variation, but a repetition of a previous course of development. It is simply a continuation of those processes which have been going on in the individual and are regarded by the observer as perfectly normal up to the point of reproducing the features of the ancestor, but are looked upon as abnormal so soon as they transcend their limits.

Inquiry into what we mean by normal and abnormal will reveal the commonly received doctrine in the case. By normal we mean according to the steps of growth of the ancestor ; that is to say, the assumption is made that it is natural or normal for reproduction to proceed in some path already traversed. Now, in fact, this is not strictly true; first, we know that species are constantly showing departure or 'abnormal' growth (using abnormal in the above sense), and the deviation is called variation; and secondly, we have reason to believe that organisms never proceed in exact imitation of anything else, that every part of every organism is in some infini-

tesimal sense different from any other. This is really a distinctive feature of organisms as contrasted with bodies of inorganic matter.

This distinction between normal and abnormal reproduction, as if variation were but a slight modification of the so-called law of reproduction, has also led us into confusion. Reproduction is but the production again of what has been produced in a previous cycle; and a case of variation in the offspring, however slight, is not a case of reproduction, but of the production in the offspring of some new character, and the great thing to account for is the fact of the production of such new characters in organisms. But the process by which the individual acquired some new character is not different in nature from the process by which it acquired the old characters already expressed by its ancestors. If we can account for growth in the first place we are on the immediate track of accounting for the continuance of growth. To say that the growth of the individual in a particular direction and to a particular degree is due to the influence of the ancestor upon the offspring is offering a cause for reproduction, but not for variation; for, however variable the original stock might be, generation would result in increasing the degree of uniformity of the ancestry of each individual. As one can easily discover by computing the total number of direct ancestors of any individual with two parents, and supposing them to belong to distinct lines in each generation, it would take but twenty-one generations back to find one's lineage spreading over a million separate individuals of the twenty-first generation. If the ancestors controlled the growth of the offspring it is thus evident that, however different might be the individuals at any particular period in the course of a hundred generations, given free access to crossing, each offspring would unite strains of influence from every possible line of ancestry which had been accessible.

If variation were the result of difference in the external conditions, or what we call environment, the question arises why should not the same variability be expressed in the phenomena of crystallization; in the phenomena of chemical combination of elements; in the phenomena of light or heat, and in all the physico-chemical phenomena of matter, where like conditions produce like effects? If we have a uniform common force at work, the varying expressions of which are due to diverse conditions of environment, why should the result be so different from any other uniform common force operating under like diverse conditions of environment? The question brings its self-evident answer; the variations cannot be explained as the reflex of a discrete and varying environment upon a uniform common kind of matter. The idea that the cycles of development of the offspring should repeat the cycles of development of the ancestors is based on the prior assumption that the organism does not normally vary; that it acts as if it were an inorganic body, subject to the law of inertia and conservation of force. With this idea, it is easy to imagine that the cycle, once started, should not stop, except by reason of some resistance or impediment.

But we ask how can the cycle begin? How can it be started? and here we come to the fundamental point under consideration. Starting is itself variation—a departure from remaining inactive; and a cycle is uniformity, not variation. If the simplest act in the world takes place, it is a diversion from the condition of things before it took place; and if it stop and is simply repeated periodically, there is a cessation of the action of the initial starting force, and we have but the continuation of reflex action of the original impulse in the midst of resisting media. Hence, to begin

a cycle of phenomena, of whatever kind, requires the initiation of the original variation in which it began. The same is true of any variation thereafter, if we are to apply the reasoning which is valid regarding physico-chemical laws of matter to the phenomena of organisms. If the variation be primitive, and normal, to use the word in the sense proposed, it is evident that what we call reproduction is but a pulsation of the phenomena of life itself, recurring in the precise cycles which express the equilibrium between a definite quantitative force in the individual organism itself and the definite quantitative forces of the total environment in which it carries on its life functions.

The preservation and perpetuation of derived characteristics in a race seem at first sight to be easily accounted for by the process which Darwin has called natural selection. Variation, in this hypothesis, is supposed to occur 'naturally,' by accident, or, as Darwin says, 'spontaneously.' But a close examination of what such a proposition would mean in concrete facts reveals serious difficulties. The apparent simplicity arises from the assumption that the law of hereditary transmission of ancestral characters is a primary law of organism, which is violated in every case of variation. On such an assumption we have only to conceive of the removal of whatever may have occasioned the accidental or spontaneous disturbance in order to permit the continuing on of the normal working of heredity. But when we follow the hypothesis back to its beginning, it provides no means for rising from the original level of simplicity. Each variation must, according to the theory, be a violation of the normal action of the organism; hence if the organism were adjusted when the variation took place the variation puts it out of adjustment, and we have no place for the action of natural selection. If, on the other hand, the variation is advantageous to the economy of the organism, then we must assume either that the organism was not in perfect adjustment when it varied; and then again the adjustment is accounted for without the action of natural selection, or else the lack of adjustment came from change of conditions. In this case the conditions of environment, not natural selection, account for the adjustment. And there seems to be a still greater difficulty, viz., the extreme length of time necessary to bring about the changes that have taken place by the process. Recently Professor Poulton called attention to the necessity of this great time period (longer than the physicists or geologists are generally ready to allow to have been possible), in order to account for the results we find recorded in the fossil-bearing rocks, requiring at least 400 millions of years for the work of evolution.* But Mr. Poulton does not exaggerate the matter.

Let us examine this time factor and see if we can imagine it to have been long enough. In the first place, if hereditary repetition be the normal law of organism, then Professor Poulton has made a fair estimate of the ages it would take according to the present rate of evolution. But he has not taken into account all the necessities of the theory, two of which must be these: First, if the exact hereditary transmission and repetition be the fundamental law of organisms, not only must the progress produced by any mode of variation have been exceedingly slow—at first at a rate decreasing geometrically in proportion to the greater simplicity of the organism; but second, the theory requires that if natural selection consists in making variations permanent, the general progress must take place by means of a process which in every particular case consists in stopping the very phenomena by which the progress is at-

*Science, Vol. 54, p, 504.

tained. It is, moreover, this becoming permanent, by hereditary acquirement of the variation, which constitutes the evolutional progress of the series. And the difficulty we meet with is that we are assuming that natural selection must actually check, or even stop that variational activity by means of which any change whatever is attained, according to the theory of a primitive law of heredity. But if we were to grant that progress could be attained in this way, and allowing the slow rate of the actual process by which a variety becomes permanent enough to be called a strain or set habit of a race, and granting Professor Poulton's demand of the necessary four hundreds of millions of years for the process at the present rate—granting all this to be possible, we have still to reckon with a still more important process, the raising of the functional importance of the new varietal modification to reach a rank of specific, generic, family, ordinal, and, before we are through with it, class, branch and subkingdom value in the individual economy. The time required for this would be practically infinite. Because, with each step in advance in taxonomic rank and importance, the rigidity of transmission must be supposed to become greater, and thus the degree of possible variability diminishingly less. This would result, even if we were to grant that the change in taxonomic rank of the character be a fact.

But the evidences of paleontology go to disprove the very matter of fact. As has been already pointed out in another place, the degree of differentiation and the classification of invertebrates of the first great era in which we have definite records of organic life are so closely in conformity with that which we know of the invertebrates of the same classes now living that all the distinctions necessary to be considered in an ordinary course of lectures to a class of students in invertebrate zoology, to-day, would apply, so far as the facts are recorded, to the organisms which lived in the earliest period of which we have definite record of any living organism on the face of the earth ('Geological Biology,' p. 212). This evidence means that the same kind of characters, which are varietal and specific characters in living organisms to-day, were varietal and specific characters in the representatives of the same classes back in the Cambrian time; that the same kind of characters which are now generic in rank were then generic characters. And, so, in the case of family, ordinal and class characters we discover no trace of evidence that characters bearing a particular rank in the organic economy now, among living beings, did not always bear the same relative position among the characters of the bodies of their ancestors.

Attention was called to these facts several years ago and their validity does not appear to have been questioned. We observe, further, that in Cambrian time the differentiations of animals of branch value had already taken place, with the exception of vertebrates; and vertebrates appeared in the Ordovicean. And in the case of the vertebrates of the Ordovicean (and only a single locality for them is as yet known) their representatives are distributed by experts into three of the five known (*i. e.*, in fossil condition) sub-classes of Fishes. Fishes, it must be observed, include the type of vertebrates which are adjusted alone to an aqueous environment, and, therefore, we may conclude that, so far as the vertebrates of the environment of which we have any record for that era are concerned, they had reached over one-half the differentiation of sub-class rank ever attained by them.

Lest there should appear to be a misrepresentation of the opinions against which these arguments are directed, quotation from Darwin's 'Origin of Species' on

this point may appropriately be inserted here.

Darwin wrote:

"Hence I look at individual differences, though of small interest to the systematist, as of high importance for us, as being the first step toward such slight varieties as are barely thought worth recording in works on natural history. And I look at varieties which are in any degree more distinct and permanent as steps leading to more strongly marked and more permanent varieties; and at these latter as leading to sub-species and to species. * * * I attribute the passage of a variety from the state in which it differs very slightly from its parent to one in which it differs more, to the action of natural selection in accumulating difference of structure in certain definite directions. Hence I believe a well-marked variety may be justly called an incipient species (p. 53).

"Therefore, during the modification of the descendants of any one species, and during the incessant struggle of all species to increase in numbers, the more diversified their descendants become, the better will be their chance of succeeding in the battle of life. Thus the small differences distinguishing the varieties of the same species will steadily tend to increase till they come to equal the greater difference between species of the same genus, or even of distinct genera (p. 117).

"Natural selection acts, as we have seen, exclusively by the preservation and accumulation of variations, which are beneficial under the organic and inorganic conditions of life to which each creature is at each successive period exposed" (p. 117).

As if to make the inadequacy of this conception more apparent, we have but to look back across the geological ages, or, accepting the law of recapitulation, to trace the embryonic development of a single higher animal, in order to discover that the earlier differentiations were of actually higher rank, and that as time has progressed the new forms of organisms have been restricted to modifications of less and less importance. The earlier in time we go the more fundamental were the variations which took place, and it is in later geological times that there has come to be more and more rigid adherence to the law of heredity.

The proposed theory of original variability is not only consistent with such a series of events, but they would be the natural expression of such a force in operation. Variability should be most active and most vigorous before the laws of heredity had restricted its action. We must not, however, confuse activity of the operation of this law with multiplicity or complexity of activities in a common body. Complexity of structure is a matter of development and adjustment of the body itself, and much collateral evolution would be necessary before it would be possible for great complexity in a single body to be consistent with the limits of its vital functions. That the changes and adjustments would be great and rapid in proportion to those that followed when the adjustments had become close and involved is, however, evident. Hence it would be consistent to expect rapid evolution at first, gradually decreasing in rate with advance of time, as paleontology teaches us to believe was the actual fact of the case.

The difficulty in the commonly accepted view, it seems to the author, arises from mental confusion rather than neglect of the real phenomenon in the case. The mental juggling takes place when we speak of varieties or variation becoming more permanent, or when we speak of the preservation and accumulation of variations.

Variation as an act means becoming different, but variation as a thing means

something which does not vary. Permanent as an adjective means lasting and enduring, and thus it is contrasted with the adjective sense of the term variable. Thus when Darwin speaks of natural selection as acting by the 'preservation and accumulation of variations,' there is nothing variable in that which is conceived of as being preserved and accumulated. It is a character or morphological structure which is preserved and accumulated in the offspring only when it is the same character which appeared in the parent form. It is the fact of the reappearance of the same character in the offspring which is meant by its preservation. It will be seen, thus, that the origin, or arrival into the organic structure, of the particular concrete variation which, in any particular case, is transmitted and preserved must necessarily have taken place before natural selection acts in that particular case. Therefore, the variation, as an act, or the actual becoming different, is of a two-fold nature: (1) It consists, first, of the growth of some part of the structure of the organism in some way and degree differently from the growth of the same part in the ancestor; and (2), secondly, there is the reproduction of that difference in the offspring in accordance with the growth as it took place in the parent or immediate ancestor. Here, in the act, we see again a confusion of two acts, one of which is permanent and the other variable. The first act is a diversion or contradiction of the law of heredity, the second act is in conformity with it. The true variation, as an act, is thus a real departure, or diversion, from the phenomena of hereditary repetition. It is this which I understand Darwin assumed to have been spontaneous or constantly occurring, and it is the operation of natural selection, chiefly, and of other agencies working upon the living organisms, which, according to Darwin, results in the increasing diversity of the individuals. We are thus led by an analysis of Darwin's own theory to find that the real variations occur prior to any of those operations of the organism, or of the environment, commonly supposed to have caused them.

Darwin's theory, nevertheless, is readily adjusted to the conception of the fundamental nature of organic variation here proposed. It requires but an expansion of the idea of mutability of species so as to include mutability of the individual and of organic matter itself. Natural selection is constantly producing heredity, not variation. But natural selection is not the only cause; environment in general, and we might extend the idea of environment and say that experience is constantly resulting in the hereditary transmission of qualities or characteristics from parent to offspring.

The definite laws of heredity for any particular organism at any particular point in its history are but the recapitulation of the experience of its ancestors in overcoming, conquering and using for their enrichment the impediments and constantly acting hindrances to their living and existence. Varying is the first, as it is the last, performance of the living being. Invariability is the law of the inorganic world, but is the sign of death among organisms. This thought was aptly expressed by the late James D. Dana, in the last revision of his 'Manual of Geology.' Speaking of variation among organisms he wrote: "It is perceived that the law of nature here exemplified is not 'like produces like,' but like *with an increment* or some addition to the variation. Consequently, the law of nature, as regards the kingdoms of life is not permanence, but change, evolution" (p. 1033).

A rational and consistent conception of organic evolution arises from this theory of the fundamental nature of variation in organisms. Evolution is, to this theory, only the extension of the phenomena of

growth, or development of the individual beyond the point reached by its ancestors. Natural selection operates in the manner set forth in the current hypothesis, only the result is confined to holding in check and regulating the cycles of individual development, not to producing them. Environment affects the organism, both directly and indirectly, as Lamarck and the Neo-Lamarckians claim, but the effect is in the way of checking and then controlling variation.

The organism is in all respects dependent for its resources upon environment. Living is a constant process of occupying, using and discarding matter, and therefore any structure or function developed by the organic body is either profitable to the continuance of the living individual, or it is not profitable. Any modification of structure has a definite economic value to the individual; if its benefit does not equal its cost in energy its production is an unprofitable venture and is either not repeated or the individual is crippled and finally lost by the operation of natural selection. If the organism, for any cause, acquires surplus energy it is expressed in variation, and if the variation is to the advantage of the individual, *i. e.*, if the resources of new energy resulting from its presence exceed the expenditure for its construction and maintenance, the result is beneficial and the new structure is retained and a step in advance is made.

Thus the condition of environment, from the old point of view, seems to cause the organism to vary; in the new view, the organism adjusts and keeps adjusted to its environment by the law of internal economy, not by the external struggle for life.

It is not neeessary, here, to suppose that there must be a specific conscious adjuster residing in each organism. We do not find it necessary to imagine a specific *erdgeist* in order to cause the earth to follow the intricate curve of its revolution among the other planets and about the sun. Nor is it necessary to assume, as Professor Bailey puts it, that "definite variation is an inherent or necessary quality of organic matter,"* but given this general law of variation as an intrinsic property or mode of operation of every particle of living matter, and the phenomena of life will result—in the lowest stage as metabolic phenomena, then in the second stage as individual development and, also, in the third stage as evolution, by simply continuing their activities. And the same power which can constitute variation among the phenomena of matter, otherwise controlled by the inflexible physical laws of inertia and conservation of force, can, doubtless, institute in living matter that still higher function, consciousness, with all the wonderful phenomena which are associated with it.

The significance of this theory is considerable, both scientifically and philosophically. From a scientific point of view, variation or variability is recognized as the very essence of the vital phenomena, as gravitation is recognized as an essential characteristic of matter. Life is as remarkable (but perhaps no more so) as that sudden demonstration of expansion which inelastic water or rigid ice exhibits when raised to 212 degrees of Fahrenheit. We might study ice and water for eternity under temperatures below the boiling point and never discover the properties of steam So, whether the vital phenomena are latent in matter or not is a matter of speculation. Whenever vital phenomena appeared they appeared in phenomena exhibited by matter. Whenever inorganic matter becomes vitalized, however that result may be accomplished, variation takes place and distinguishes it from matter in every other condition.

*'The Survival of the Unlike,' p. 22.

If anything be evolved by evolution it is evident that, whatever its nature may be, it must cease to be evolved if it would maintain its integrity. For inertia of matter and conservation of force apply to bodies which no longer are undergoing evolution. Variation, as a process of becoming different, is a characteristic of living bodies, and, though it is not doubted that in the phenomena of variation it is ordinary chemical and physical matter which exhibits the peculiar vital phenomena, we have no reason to suppose that the operations of physics and chemistry are thus variable.

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MICROSCOPICAL EXAMINATION OF WATER, WITH A DESCRIPTION OF A SIMPLE FORM OF APPARATUS.

THE microscopical examination of water is becoming every year a matter of greater interest, and the study of the minute aquatic plants and animals is more and more attracting the attention of scientists. These organisms are interesting for several reasons and, besides recognizing their importance in the domain of pure science, we are beginning to appreciate the great part that they play in nature and their effect, direct and indirect, upon the human being. Their presence in surface waters is often the cause of much harm when the water is used for purposes of domestic supply; scores of instances may be mentioned where they have rendered the water entirely unfit for use. On the other hand, their presence in ponds and streams is of importance to the fish-culturist because they form the fundamental source of the food supply of fishes; this is probably true both of salt and fresh water.

Because of this connection between the number of microscopical organisms in a cubic centimeter of water and the price of fish in our markets, the study of the 'plankton,' *i. e.*, the floating micro-organisms, is being emphasized on both sides of the Atlantic. Observers are beginning to trace the connection between the presence of microscopical organisms and the abundance of fish in our lakes, and valuable comparisons have been made between the stomach and intestinal contents of fishes and the organisms found in the water where the catches were made. This work is of very great importance and should be vigorously pursued by our fish commissions. To be of the greatest value it should extend well over the country and include lakes and ponds sufficiently different in character to enable one to determine the laws governing the nature and distribution of the plankton in various climates and under various conditions. The study ought not to be carried on spasmodically, as, for instance, during the short vacation of some college professor who generously gives his time and talents to the cause, but should be undertaken seriously and continued throughout the whole year. Only in this way can we obtain the data necessary for a complete understanding of the subject.

Since water works managers are equally interested in the microscopical organisms found in surface waters, and up to the present time have been responsible for most of the work done upon the subject, it might be possible for fish commissions, boards of health, water-works superintendents, and others interested, to work together according to a definite concerted plan, sending their results to some central commission or committee for comparison and study. Such an extended biological study taken in connection with meteorological records and observations upon the temperature, transparency, etc., of the water would be of very great value. And it would seem that we have little excuse for neglecting to cultivate this fruitful field of research. Vast num-

bers of microscopical examinations are now being made [during the past eight years more than 40,000 have been made in Massachusetts alone], and the rapid growth of the new science of sanitary biology is developing numbers of well-trained observers wide awake to the value of these problems and well able to undertake the work. What is needed is cooperation.

Various methods have been employed from time to time for determining the character and amount of microscopic life in water. Those interested in the subject from the piscatorial standpoint have usually employed some sort of net for straining the organisms from the water and concentrating them for the microscope. One of the best devices of this kind is that devised by Professor Reighard and used with good results for studying the plankton in Lake Michigan. It consists of a conical net of fine bolting cloth, at the small end of which there is a 'bucket,' made by covering a metal framework with some of the same bolting cloth. The apparatus is hauled through the water, filtering a column of water whose cross section is the same as the circular mouth of the net and whose length is equal to the distance through which the net is hauled. The organisms are caught by the fine bolting cloth and are ultimately washed into the bucket. The collected material is then removed by an ingenious arrangement, measured and sent to the laboratory for microscopical examination. By this method one is enabled to get a good idea of the total amount of suspended matter in the water, but it can hardly be called an accurate method of obtaining the number of living organisms present, as the net sweeps in amorphous matter as well as organisms and some of the smaller forms undoubtedly escape through the bolting cloth. Moreover, the amount of water actually filtered cannot be told with a great degree of accuracy. Nevertheless, the method is one of value, particularly for securing the larger and rarer forms of rotifers, crustacea, etc.

Sanitarians who have studied the microscopical organisms in water supplies have usually employed very different methods from the above, partly because they have been interested more especially in the smaller forms, but chiefly because their operations have been confined to the small quantities of water sent to the laboratories for analysis. During the last decade the old methods of sediment examination have given way to the filtration methods. The Sedgwick-Rafter method, which is most used at the present time in laboratories of water analysis, is carried on as follows:

A portion of the water to be examined is measured out in a graduate and filtered through a thin layer of quartz sand placed at the bottom of a glass funnel upon a perforated rubber stopper, the hole in which is capped with a disc of bolting cloth. When the water has filtered, the organisms will be found upon the sand, while the filtered water will be free from them. The rubber stopper is then removed and the sand washed into a test tube, with a measured quantity of distilled water delivered from a pipette. Usually 250 or 500 c. c. of the sample are filtered and the sand washed with 5 c. c. The test tube is then thoroughly shaken and the water decanted into a second tube; the organisms being lighter than the sand, will pass off with the water, leaving the sand clean upon the walls of the first tube. In this way the organisms are concentrated 50 or 100 times. One c. c. of this concentrated fluid is then transferred to a counting cell, which just holds it and which has a superficial area of 1,000 sq. mm. After putting a thin glass coverslip over this cell it is transferred to the stage of the microscope for examination. The eye-piece of the microscope is fitted with a micrometer in the shape of a ruled

square of such a size as to cover one sq. mm. on the stage, *i. e.*, one thousandth of the entire area of the cell. The organisms observed within the limits of the ruled square are then counted and the cell moved until another portion comes into view, when another count is made. Thus 10 or 20 squares are counted and the number of organisms present in the sample calculated.

This process has many things to be said in its favor, and it is undoubtedly the best all-around method for the study of the plankton. The apparatus required is simple, inexpensive and not liable to get out of order. The process is neither long nor difficult, and if care and cleanliness are observed in the manipulation very accurate results may be obtained. Ordinarily the quantity of water operated upon is small, but there is no reason why large filters may not be used. The writer has frequently used a funnel having a neck one inch in diameter, filtering from 1,000 to 10,000 c.c. This, when used with an aspirator to hasten the filtration, has given excellent satisfaction. The chief objection to the Sedgwick-Rafter method is that delicate organisms are liable to be crushed upon the sand, and this danger is naturally somewhat greater when this aspirator is used. It is probably no greater, however, than in Reighard's net.

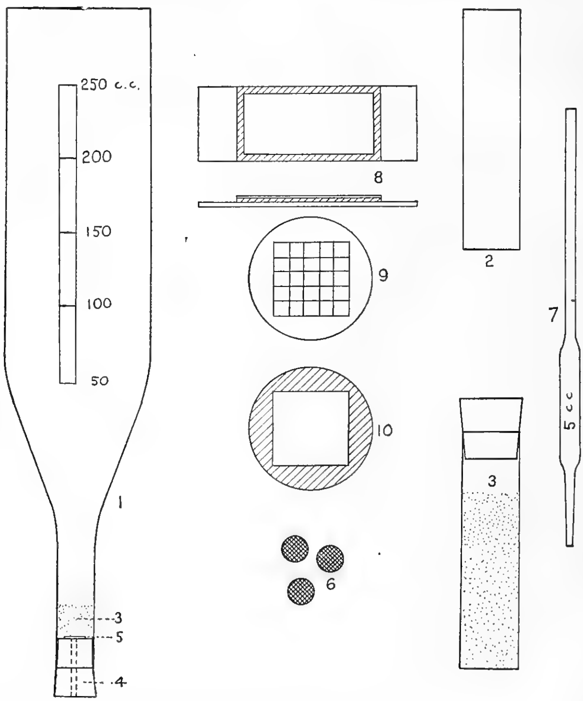
Recently a new apparatus has been devised for the study of the microscopical organisms, known as the planktonikrit. This is a modification of the centrifugal machine and depends upon the fact that the specific gravity of the organisms is different from that of water. It has the advantage of avoiding, to a certain degree, the crushing of the delicate infusoria, but it is somewhat inaccurate in the case of some of the lighter organisms; furthermore, it operates upon very small quantities of water.

In a complete study of the microscopical organisms, such as might be undertaken on cur great lakes, for example, it would be advisable to use all three methods, adopting the Sedgwick-Rafter method for general quantitative work, but using the net and centrifugal apparatus for determining the rare and delicate organisms.

As there are many lovers of the microscope who are interested in studying aquatic life, and as there are many others connected with water-works to whom the study of algæ and infusoria would be of much value, the writer has tried to reduce the Sedgwick-Rafter method to its simplest possible elements in order that it may be more generally used. Furthermore, it is often necessary for the sanitary biologist to be provided with a portable outfit for work in the field. There are many fragile organisms which will not bear transportation to the laboratory. Uroglena, for example, a very important and troublesome organism found in water supplies, goes to pieces completely when kept for a short time in a stoppered bottle. It is, therefore, necessary to make the examination of water immediately after the collection of the sample.

The chief modification of the method for field work consists in the use of a cylindrical glass funnel [Fig. 1] similar to the one designed by Mr. D. D. Jackson for the Massachusetts State Board of Health, but differing from it in having a capacity of 250 instead of 500 c.c., and in having graduations marked upon the sides. This funnel may be conveniently carried and its graduation renders the use of a second measuring glass unnecessary. When in use it may be supported on a wire frame, which any ingenious person can make. In place of the test-tube it has been found convenient to use tube vials [Fig. 2] having square ends. These require no racks and are not easily tipped over. The pipette for washing the sand might be dispensed with if one of the tube vials was graduated, but as much depends upon ac-

curacy in concentrating the sample it is best to use a short pipette [Fig. 7]. The sand [Fig. 3] used in the filter should be perfectly clean and of such size that its grains will pass through a sieve having 60 meshes to the inch, but not through one having 100 meshes. Crushed quartz makes the best filtering material and should be



used when obtainable. The discs of bolting cloth [Fig. 6] may be easily cut out with a wad cutter. The filtered water may be used for concentrating the organisms, or it is possible to employ preservative fluids in case the microscopical examination must be deferred or it is desired to keep the specimens. The cell [Fig. 8] for holding the concentrated fluid may be made by cementing a brass rim to an ordinary glass slip. It should be 50 mm. long, 20 wide and 1 mm. deep, thus holding just 1 c.c. and having a superficial area of 1,000 sq. mm.

A very simple microscope will answer for this work. A large stand is too valuable and too heavy for the rough usage in the field, and a cheap, light stand with a $\frac{1}{2}''$ or $\frac{2}{3}''$ objective and a No. 3 ocular will answer equally well. The ocular must be provided with a micrometer, so that the observer may count the number of organisms in one cu. mm. of the cell. A disc of glass ruled as in Fig. 9 is the best form of micrometer,

but a piece of thin metal with a square cut out, as shown in Fig. 10, may be substituted. In either case the square must be of such a size that it covers one sq. mm. on the stage with a given combination of objective and ocular, and a certain tube length to be found by comparison with a stage micrometer. It is an advantage to have at hand higher powers for a more thorough study of the organisms met with, but for ordinary work the powers suggested are sufficient.

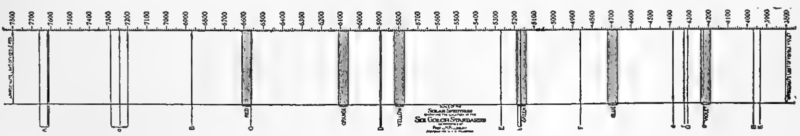
All this apparatus, together with bottles for collection and note book for records may be carried in a grip sack, and this will be found generally the most convenient way. It is possible, however, to make a neat box, with compartments for holding the microscope, funnels, tube vials, etc., and I respectfully submit this to manufacturers of microscopical supplies.

GEORGE C. WHIPPLE.

NEWTON CENTRE, MASS.

SPECTRUM COLOR STANDARDS.

THE extensive adoption of the *color standards* proposed by me and put into practical form for educational purposes by Mr. Milton Bradley, of Springfield, Mass., leads me to offer the readers of SCIENCE an opportunity to examine a chart of the solar spectrum after Rowland with the standard colors located upon it. The importance of making the spectrum the basis of all our work in color is recognized by all, and I have received many appreciative communications from eminent men in scientific and educational circles, both in this country and England, expressing approbation of the effort to bring our now greatly confused color nomenclature within some accurate and practical system. The idea of teaching color by a system thus definitely defined has also proved to be very practical, not only in elementary instruction, but in the more exacting art work. This rapidly increasing public interest in the subject makes it seem likely that the accompaning chart will be of interest.



A few observations on the practical application of these standards will illustrate the value of the scheme. The area representing each particular standard in the chart is narrow enough to allow of no perceptible difference in the hue of the two sides of the area when viewed through the spectroscope and is still wide enough to give a clear working field. Moreover, the areas selected coincide with the views of a large number of persons experienced in the discrimination of color and well prepared, therefore, to judge what would be of practical value as color standards and applicable to the various needs of the arts as well as to science and to educational purposes. And still again, though there was no direct reference to the theories of color vision, these standards having been first proposed nearly fifteen years since, the standards prove to have been happily selected as regards the more recent theories of color vision. Another very important consideration is the fact that the quality of any color which I have yet seen can be obtained by the union of two of these standards. Of course, the intensity of one of the two compared colors will generally have to be modified to obtain a perfect match, but I have never yet been unable to do this. In a

series of comparisons now before me, including many of the brilliant colors of silk ribbons recently so fashionable, I have had to reduce the intensity of the color to be reproduced, in only two out of sixty cases. This comparison was made by means of Maxwell discs made from the Bradley educational papers. For all practical purposes some form of paper or card board disc seems more convenient and proves quite satisfactory, as the above statement shows While it is possible to get somewhat more of brilliancy in silk than in pigment-covered papers, I have not found the increased brilliancy of sufficient value to compensate for the difficulty of making silk-covered discs that can be conveniently operated.

For educational purposes it seems to me of first importance that the child (and many adults are children in this regard) should start out with some clear and correct idea of a few pure spectrum colors. It does not matter essentially just how many of these colors he is taught, only that he gets a definite conception of those of which he learns. The reason for taking six for this series of standards was that I found that it was very difficult to get any practical scheme of color teaching based on a less number of standards. The mixing of two standards by means of the color wheel always reduces the strength of the resulting color. For example, the mixing of red and yellow on the wheel will produce orange, but it will not be as strong an orange as that of the standard paper. It will be a broken orange. Using the nomenclature adopted in my former articles (Science, February 26, '92, and June 9, '93) we have the result represented as follows: R 82 Y 18 gives the same effect as O 55 W 2 N 43. This can be best tested by using two sizes of discs. The larger should be compounded of red and yellow in the proportions just given and the smaller of orange, white and black as indicated. In this way the result is very satisfactory in fairly strong and pure diffused sunlight. The same principle will apply to all the colors of the spectrum. But the extent to which the effect of a broken color is produced will be increased, as the colors differ more widely in luminosity, or are more widely separated in the solar spectrum. Hence a smaller number of standards makes the practical use of the standards more difficult in the pupil's study of the colors by the use of the Maxwell discs. If we take a larger number of colors than six it becomes more difficult to designate them clearly in the solar spectrum, and the system becomes more complex. As there is quite general agreement that indigo shall not be used as a name for a spectrum color, the most natural and far the most convenient terms are those used in the scheme already referred to. When the pupil becomes familiar with these standard colors he is prepared to make very rapid progress in color study. The combination of these standards will give a ready appreciation of the nature of the purer color in objects about him and prepare the way for the analysis of colors, first those of a pure tone and afterwards of broken colors. The next stage would be the teaching of color harmonies. This most difficult part of the work becomes relatively easy by means of educational papers constructed on so simple a plan as this. It is surprising to see what results are obtained in the schools where this system has been followed.

It seems not inappropriate in this connection to call attention to an attempt to apply the principles upon which I have worked with a somewhat different set of standards from those I have used under the article 'spectrum' in the Standard Dictionary. In the first place there is no pure red used in the system, that called red being an orange red, as represented by the pigment vermilion. Nor is there any violet

used in the scheme, except by an unintended blunder, by which the wave-length of ultramarine is given as .4250, which would bring the standard blue designated into the clear violet of the spectrum and not distinguishable from the violet of my standards. The wave-length of ultramarine is not far from .4500. With no pure red or violet in a scheme of standard colors it is quite impossible to obtain or to represent accurately a very large line of important hues. The author of the article has been obliged, because of this defect in the standards he has selected, in many of the analyses of popular colors given in the table accompanying the article, to use three or four standards to represent the color he has analyzed where two pure spectrum colors are all that are needed. It is to be regretted that a publication like this should have added anything to the confusion which we are seeking to remedy. And this is still more to be regretted because the publishers of the Dictionary asked for and received from me the measurements and explanations of the plan upon which I had been working with the professed purpose of furthering the extension of the plan. This will not be as serious a matter, however, as it otherwise would have been, since the rapid introduction of the Bradley papers into the public schools gives an opportunity for the correct teaching of color to an enormous number of children.

J. H. PILLSBURY.

STONEHAM, MASS., June, '97.

PLEISTOCENE FOSSILS FROM BAFFINLAND AND GREENLAND.

THE existence of Pleistocene deposits in Labrador,* in several of the islands of the Arctic archipelago,† and in northern Greenland,‡ has been made known by several observers, but, so far as the writer is aware, none have previously been reported from Baffinland. The discovery of Pleistocene shells during the past summer on the south coast of Baffinland is, therefore, of interest as showing that at least a part of this island, which is the largest of the Arctic archipelago, was also affected by the subsidence which lowered the lands to the north and the south of it beneath the sea during the Pleistocene.

* Mem. Bost. Soc. Nat. Hist., Vol. 1, pp. 229–230.

† Jour. Geol. Soc., Vol. 9, p. 317.

‡ Jour. Geol. Soc., Vol. 3, p. 100.

Short trips were made into the interior by members of the Cornell University party from two points on the coast north of Hudson Strait. The first of these excursions was from a point opposite Big Island, in about long. 70 W., and the second some ten or twelve miles east of the first. At both localities Pleistocene shells were found in small lake basins a short distance from the coast at elevations from 100 to 200 feet above sea level. At two localities the shells were found in abundance, occurring in a fine blue clay mixed with some sand. These fossiliferous deposits do not occur in all of the basins and valleys, which are very numerous in this region. In most of them they appear to be absent.

The following is a list of the species arranged in the order of their abundance, which were obtained from a deposit of blue clay about 150 feet above sea level:* *Saxicava arctica*, *Mya truncata*, *Rhynchonella psittacea*, *Astarte compressa?* *Balanus crenatus*, *Pecten icelandicus*, *Lepeta cæca*.

In the interior of Big Island, Mr. T. L. Watson found Pleistocene shells at an elevation of 270 feet. The species which he obtained are *Mya truncata* and *Macoma subulosa*.

The Greenland shells are especially interesting because of the peculiar manner of

* The writer is indebted to Professor H. S. Williams for the use of specimens for comparison, and to Miss Katharine J. Bush for assistance in the determination of species.

their occurrence. All of them were obtained from the moraine fringing the margin of the ice cap along the base of the Nugsuak peninsula. The peninsula is a narrow mountainous tongue of land extending a little south of west from the mainland. Glaciers extend down to the fjiords from the ice cap on either side of the Nugsuak peninsula, while along its eastern base the ice cap terminates generally in a gently sloping margin, but sometimes in vertical cliffs forty to eighty feet high, which face small ponded lakes. From the Cornell glacier the margin of the ice cap rises gradually for a distance of four or five miles until it reaches an elevation of about six hundred feet, and then gradually descends again toward the glacier entering the fjord to the north. The morainal material, which occurs everywhere except at the lakes, just at the edge of the ice, was found to contain shells or fragments of shells up to the highest elevation which it attains, about 590 feet, at a distance of about four or five miles from the coast. At some of the small lakes the ice cliffs show distinctly stratified ice which carries an abundance of débris in the lower layers. Shell fragments were observed in the face of one of these cliffs at an elevation of 390 feet above sea level. Broken shells were also observed in the morainal material which has been dumped on the surface of the ice at a few points, owing to the sharp dip of the ice strata which brings the lower débris-carrying layers to the surface before they reach the outer margin of the melting ice.

The following species have been identified in the material collected from the moraine: *Saxicava arctica*, *Mya truncata*, *Macoma subulosa*, *Balanus crenatus*, *Yoldia* (*Portlandica*) *arctica*, *Cardium ciliatum*.

Many of the shells from the moraine near the fjord, which have evidently been carried but a short distance, have been handled in a surprisingly delicate manner by the ice. The *Macomias*, which are so fragile as scarcely to allow removal from the soft clay without crushing, have in many cases escaped from the ice without the slightest injury. The only specimen of *Yoldia* found still retained the epidermis, and the valves remained attached. In following the moraine back from the fjord toward the higher land which separates the Cornell and the Wyckoff glacial basins, the shells in the moraine become more and more fragmentary and broken as the irregularity of the land topography underlying the ice, and the distance which they have been transported, increases.

The occurrence of these shells in the moraine and in the ice makes it clear that they have been picked up by the ice from an old sea bottom which is now occupied by the ice cap. From the position of the shells and the direction of the ice flow which has transported them, the sea must have extended up the fjord when the shells were living at least four or five miles beyond the present face of the glacier. There seems to be only two possible interpretations of the relation of these shells to the ice. They either belong to a time previous to the beginning of extensive glaciation when the sea extended up the fjords as far as their slopes would permit, or they represent a retreat of the ice which allowed the sea to extend some miles up the fjord beyond its present limit, followed by a re-advance of the ice. If the former supposition be correct, the removal of shells must have been in progress from the beginning of glaciation in the region to the present time. It would seem that so long a period of excavation by the ice would have exhausted the material from so limited a supply. According to this theory, morainal material formed at an earlier period, when the ice extended beyond its present position, ought to contain shells as well as that now forming. I care-

fully examined such material for shells, but found no traces of them. These shells do not then belong to a preglacial fauna. The true interpretation of their history seems to be that there has been a retreat of the ice front some miles beyond its present position and a re-advance.

The remaining problem is, to what was the retreat and re-advance due, and when did it occur? The retreat was probably caused by the general subsidence in the north which is indicated by elevated deposits of recent shells in Baffinland, Grinnell Land and Labrador. A depression which amounted to 1,000 feet in Grinnell Land, and affected all or nearly all of the Arctic archipelago and probably Greenland, must have greatly increased the water area in the north and caused a corresponding rise of temperature. This rise of temperature would undoubtedly cause a retreat of the glaciers, permitting the sea to extend much farther up the fjords than at present, and in the shells which the ice cap is now carrying from the valleys of the interior we have proof that such a retreat occurred. With the elevation of the land in the north again, a lower temperature prevailed and the ice recovered some of its former territory.

E. M. KINDLE.

YALE UNIVERSITY, December 8, 1896.

CURRENT NOTES ON PHYSIOGRAPHY.

THE SIERRA NEVADA.

'FURTHER Contributions to the Geology of the Sierra Nevada,' by H. W. Turner (17th Ann. Rept. U. S. G. S., 1896, 521–1076) contain many geographical items. Oroville table mountain is illustrated in an excellent plate. The deep, steep-sided canyons that have been cut into the uplifted mass of the range often have benches on their slopes, caused by landslides; these, with the falls in the streams and the inaccessible character of the canyons, may be taken as features of a youthful stage of geographical development. Associated with them as indications of recent uplift are occasional fault scarps, still steep and bare; one of these being shown in a plate. Of a little greater age are the fault-block lake basins, now drained by filling with sediments and cutting down at the outlet; Meadow valley being of this class. Mohawk valley, first holding a Pliocene lake in a fault basin, was afterwards obstructed in Pleistocene time by fragmental andesite flows. Much of the volcanic material, once broadly spread over the Sierra area and now greatly dissected since its regional uplift, is shown to be fragmental, coarse and fine, less or more stratified; it is compared in origin to the mud flows of modern volcanoes. The flows came from the crest of the range, and ran for fifty miles on the comparatively gentle slope of the then low-lying region. The 'hog-wallow' mounds on the valley plain and margin of the foothills are described and illustrated, but not definitely explained; they are one or two feet high, four to ten feet in diameter, and of the same pebbly soil as that on the intervening spaces.

NORTH CAROLINA AND ITS RESOURCES.

'NORTH CAROLINA and its Resources' is the title of a volume published by the State Board of Agriculture (Raleigh, 1896, 413 p., many plates), to which the geographer may refer with profit. The mountains, with their minerals, mines, forests, and attractive 'resorts;' the piedmont belt, with rich fields and great water powers, the coastal plain with its growing interests in truck farms and orchards, and the sounds with their fisheries, are all duly set forth. This report forms a fitting companion to a volume on 'South Carolina, resources and population, institutions and industries,' published some years ago by the State Board of Agriculture (Charleston, 1882).

The latter lacks illustrations, but has a soil map.

DUNGENESS FORELAND.

Dr. F. P. Gulliver continues his studies on Cuspate Forelands (Bull. Geol. Soc. Amer. VII., 1896), by a study of Dungeness foreland, on the southeastern coast of England, one of the best examples of its class; having read his paper on this subject at the Liverpool meeting of the British Association in 1896 (London Geogr. Journ. IX., 1897, 536–546). He gives a restoration of the initial shore line of the region, and outlines of successive stages in the growth of the foreland, whose cusp has grown eastward and outward during its enlargement. It now projects about ten miles into the channel from the original reentrant of the coast; near the apex the shingle ridges or 'fulls' indicate the lines of progressive growth with much clearness. It is noted that English sailors have recognized forms in other parts of the world similar to this homė example, and have applied the home name to two widely separated forelands; one in Puget Sound, the other in the Strait of Magellan.

A FAULT LINE IN AFGHANISTAN

An account of the southern borderland of Afghanistan by Captain McMahon (London Geogr. Journ., IX., 1897, 392–415) includes a description of a remarkable fault line, along which the topography of a growing displacement is visible. It was examined for a distance of 120 miles, on an almost direct course a little east of north, near the southeastern corner of Afghanistan; a well defined broad line of deep indentation, in many places as distinct as a deep railway cutting. It ran for a time along the border of the Registan plains, then obliquely traversed two mountain ranges, cutting the crest of one near its highest peak. Springs are common along it, and for this reason as well as because it forms a short cut across mountain spurs, the depression is commonly used as a thoroughfare. Igneous rocks form the country to the west, and sedimentaries lie to the east of the fault line. During the lifetime of the older natives, on the occasion of three severe earthquakes, deep fissures appeared along the depression, and the springs increased in volume. The line crosses a frontier railway near Chaman, beyond Quetta. A severe earthquake on December 20, 1892, opened a fissure where the fault crossed the track, distorting the rails, and lessening the distance between Quetta and Chaman by 2½ feet. All the region is desert—bold, barren mountains, stony slopes, shifting dunes, alluvial and saline plains; many camels died in McMahon's trip across it.

W. M. Davis.

Harvard University.

SCIENTIFIC NOTES AND NEWS.

Professor Alfred M. Mayer, the eminent physicist, died at Maplewood, N. J., on July 13th, aged sixty-one years.

On the recommendation of Hon. Chas. D. Walcott, acting Assistant Secretary of the Smithsonian Institution, in charge of the U. S. National Museum, an important change has been made in the administration of the Museum. Three sections have been organized—a section of anthropology, a section of biology and a section of geology, each having a head curator with an annual salary of $3,500. Dr. W. H. Holmes has been appointed head curator of anthropology; Dr. Frederick W. True, head curator of biology, and Dr. George P. Merrill, head curator of geology. Dr. True and Dr. Merrill are already connected with the Museum, and it is expected that Dr. True will continue to act as the executive curator. Dr. Holmes leaves the Field Columbian Museum, Chicago, to accept this position, but was formerly connected with the U. S. Geological Survey and the Bureau of Ethnology.

The Berlin Academy of Sciences made, at its last meeting, awards for scientific purposes

amounting to nearly $20,000. These awards were as follows: To Professor F. E. Schültze for the publication of *Das Tierreich* under the auspices of the Zoological Society, 35,000 M.; for the publication of the new edition of Kant's works, 25,000 M.; to Professor Engler for the publication of monographs on African botany, 2,000 M.; to Dr. G. Lindau for studies on Lichens, 900 M.; to Professor F. Frech for his geological studies, 1,500 M.; to Professor H. Hürthle for studies on muscles, 850 M.; to Professor R. Bonnet, for the preparation of a work on blood vessels, 800 M.; to Dr. Lühe, for investigations of the fauna of salt lakes of North Africa, 2,000 M.; to Dr. G. Brandes, for studies on Nemertina, 300 M.; to Dr. R. Hesse for investigations at Naples on the eyes of lower marine animals, 500 M.; to Professor E. Cohen for investigations of meteorites, 1,500 M., and to Dr. L. Wulff for experiments on artificial crystals, 1,500 M.

THE Academy of Sciences of Vienna celebrated, on May 30th, the fiftieth anniversary of its foundation. The government made this the occasion of increasing the annual subsidy of the Academy from 40,000 to 50,000 Fl.

THE German Zoological Society held its seventh annual meeting from the 9th to the 11th of June at Kiel. We learn from *Die Natur* that the program we have already announced was carried out, except that the president, Professor Bütschli, was unable to be present and the meeting was presided over by Professor J. B. Carus. There were thirty-seven members and thirteen guests in attendance. It was decided to hold the next annual meeting at Heidelberg at Whitsuntide.

THE eightieth meeting of the Swiss Scientific Association will be held at Engelberg from the 12th to the 15th of September. The place of meeting is in the midst of fine Alpine scenery a three and a-half hours' drive from the nearest railway station. American men of science are cordially invited to be present.

THE Anatomical Society, intended to be international in character, but chiefly supported by German anatomists, held its eleventh meeting at Genth from the 24th to the 27th of April, with fifty members and guests in attendance. The President, Professor Waldeyer, discussed anatomical nomenclature, and papers were presented by Professor O. Schültze, Professor v. Kölliker, Professor v. Bardeleben and others. The next meeting will be held at Kiel during April of next year.

THE preliminary program of the first International Congress of Mathematicians, to be held at Zurich from the 9th to the 11th of August, announces that in addition to two general meetings there will be six sectional meetings as follows: Arithmetic and algebra, analysis and theory of functions, geometry, mechanics and mathematical physics, astronomy and geodesy, history and bibliography. At the general sessions the following papers will be presented: 'On the relations between pure analysis and mathematical physics,' by Professor H. Poincaré; 'On the recent development of the general theory of analytical functions,' by Professor A. Huritz; 'On the teaching of higher mathematics,' by Professor F. Klein; On *Logica Mathematica*, by Professor G. Peano. The dues for the Congress are 25 fr., which sum includes the cost of the banquet and other entertainments.

THE second of the annual conversaziones of the Royal Society was held on June 16th. Demonstrations with illustrations were made by Mr. W. H. Preece on signalling through space without wires, and by Professor Lockyer on the arrangements of the 1896 eclipse expeditions. There were exhibits by Lord Kelvin of the electrical effects of uranium and of X-rays, by Professor S. P. Thompson, Mr. A. A. C. Swinton, Dr. John Macintyre, Dr. J. H. Gladstone and Mr. Walter Hibbert. There were also other interesting exhibits, both in the biological and in the physical sciences.

THE annual field meeting of the Indiana Academy of Science was held at Lafayette from the 26th to the 28th of May, with an attendance of forty members. Excursions were made in the surrounding regions, and an address was given by Professor Frederick Starr, his subject being 'Dress and Ornament.'

PROFESSOR A. C. GREENHILL, of Woolwich; Professor J. V. Jones, of Cardiff, and Professors John Perry and W. E. Ayrton, of London, have expressed their intention of being present at

the Detroit meeting of the A.A.A.S. and participating in the proceedings of the section for physics.

THE Albert medal of the Society of Arts, London, has been awarded to Mr. G. J. Symons for his services to meteorology.

THE Senckenberg Society of Natural History at Frankfort has awarded the Sommering prize, consisting of a medal and 500 M., to Professor Gustav Born, of Breslau, for his researches on the growth of the larvæ of amphibia.

THE death is announced of Dr. P. Schützenberger, professor of chemistry at the Collège de France, at the age of sixty-seven years. He had been since 1888 member of the Paris Academy of Sciences and had made important contributions to organic chemistry.

WE also regret to announce the following deaths: Dr. Alfred Moquart, professor of anatomy at Brussels, on June 5th; Professor Martin Wilckens, of the Agricultural School of Vienna, on June 10th, at the age of sixty-four years; Count Victor Trevisan di S. Leon, the cryptogamist, in Milan, on April 8th, and Frau Dr. Vera Bogdanowskaja-Popoff, on May 8th, as the result of an explosion while carrying on chemical experiments.

DURING the Moscow meeting of the International Medical Congress a statue to the eminent surgeon Pirogof will be unveiled. The sum of 12,000 roubles (about $6,000) has been collected by public subscription for the statue, the sculptor of which is Mr. V. R. Sherwood.

M. HATT and Professor de Lapparent have been elected members of the Paris Academy of Sciences.

MR. F. D. GODMAN has been elected President of the British Ornithologists' Union.

PROFESSOR P. ROUSSELOT, of the École des Hautes Études, Paris, has been appointed director of the laboratory for experimental phonetics, the establishment of which under the Collège de France we recently announced.

MR. HENRY L. BRYAN has been appointed, by the trustees of the Philadelphia Commercial Museum, Secretary of the Museum.

THE U. S. Civil Service Commission announces a competitive examination, on August 9th, for the purpose of establishing a register from which certification may be made to the position of Examiner, Mint Bureau, Treasury Department, at a salary of $2,500 per annum. The duties of the position comprise the inspection and supervision of all the machinery installed in different U. S. mints throughout the country. Applicants should be graduates of recognized technical schools giving courses in mechanical engineering, or should, in lieu of this, have very broad training and experience along the lines of mechanical engineering.

PRESIDENT JORDAN has passed through Seattle on his way to Alaska. He is accompanied by Professor Wood, of Stanford University.

MR. H. W. TURNER, of the U. S. Geological Survey, and Professor John C. Branner, of Stanford University, are engaged in exploring in the region of the Yosemite and Hetch-hetchy Valleys and the adjacent mountains.

MR. R. W. PORTER and Mr. A. V. Shand, who are accompanying Lieut. Peary on his present expedition, expect to spend the winter in Baffin Land making ethnological and zoological studies and collections. They expect, in the summer of 1898, to explore the country northward and to return on a whaling ship from Cumberland Sound to Aberdeen.

THE men of science who will embark on the 'Belgica' on its approaching expedition to the Antarctic regions will be as follows: The captain, M. A. de Gerlache, geology, meteorology and oceanography; M. Arctowski, terrestrial magnetism and physics; M. Danes, zoology, and M. Racovitza. The crew have already embarked in Norway and it is expected that the steamship will leave Antwerp on the 25th of the present month. The men of science expect to spend the Antarctic winter in Victoria Land, while the steamship will go to Melbourne to renew its stores.

PROFESSOR F. A. STARR has returned to the University of Chicago, from an expedition to New Mexico, having explored one of the mesas and one of the caves of the Cochitas, and having secured plaster casts of the busts of a number of Pueblo Indians.

THE Canadian Pacific Railway Company will sell first-class return tickets to members of the British Association from Toronto to the Pacific Coast, at a rate varying between $61.80 and $70.30, according to the route selected. This is less than a single fare and the tickets are available from July 1st to October 1st.

DARWIN'S family have presented to Cambridge University the geological specimens found during the voyage of the 'Beagle' and a series of slides used in the preparation of his monograph on the Cirripedia. The former has been placed in the Museum of Geology, the latter in the Museum of Zoology.

IN celebration of the Cabot quatercentenary the foundation stone of a memorial tower to be erected on Brandon Hill, Bristol, was laid on June 25th. The tower will be 100 feet in height, squarely built with emblematic panels. Some of the bas-reliefs will be contributed by an American committee, the President of which is Mr. Bayard, lately Ambassador to Great Britain. Lord Dufferin made a speech describing what little is known of Cabot and the adventurous voyage of the 'Matthew' and its importance for the extension of Anglo-Saxon civilization.

THE Geological Society of Portugal opened on July 8th the new Geographical Institute founded at Lisbon in commemoration of the 400th anniversary of Vasco da Gama's departure for the Indies.

THE Academy of Medicine of Paris has received a legacy of 15,000 fr. from Mme. Clarens for the foundation of an annual prize.

THE scientific library of the late Sir G. Humphrey, professor of surgery at Cambridge, has been presented by Mrs. Humphrey to the surgical department of the University.

THE town of Middletown, N. Y., receives, by the will of the late Mrs. S. Maretta Thrall, $30,000 for a public library. She had already given the town a hospital and a park, the value of her gifts aggregating $80,000.

THE Board of Education of the City of New York has adopted a resolution providing for the employment of oculists to report upon the best colors to be used in painting and decorating schoolrooms with reference to their effects on the eyesight of children.

REPRESENTATIVE LACEY, of Iowa, has introduced a bill in the House of Representatives providing that the name of the Fish Commission shall be changed to the Commission of Fish, Fisheries and Birds. It is proposed that the Commission shall extend its jurisdiction to provide for the propagation, distribution and restoration of game and other wild birds of the United States. It is not likely that this change will be made, as wild birds and mammals are already provided for under the Department of Agriculture, and any extension of the work should be developed under that Department.

BEGINNING with the number for July, the *Physical Review* will be published by the Macmillan Company in two volumes annually. These volumes will begin in January and July respectively, and will each contain about five numbers.

Natural Science for July, now published by J. M. Dent & Co., and printed by Turnbull & Spears with improved typography and better paper, contains articles by Professor Bashford Dean on the Hopkins Seaside Laboratory of Stanford University, and by Dr. P. L. Sclater on 'The Proposed Zoological Park in New York.' *Natural Science* should have given credit to *Nature* for the queer note to the effect that Professor Putnam and Dr. Boas have started on a six years' expedition to study the relation of the American Races to those of Asia and Africa. "They will proceed up the northwest coast of North America, cross Behring Strait, and so pass down through eastern Siberia into China, and thence along the Indian Ocean to Egypt."

THE presidential address by Dr. G. W. Hill before the American Mathematical Society in 1895, printed in the issue of this JOURNAL for March 6, 1896, is published in the current number of the *Revue Scientifique*. It is credited as a presidential address before *l'Association scientifique americaine.*

PROFESSOR RÖNTGEN has contributed to the *Berichte* of the Berlin Academy an account of further observations on the properties of the X-rays. He has observed that the rays emanate from the irradiated air in all directions so

that if the rays were visible the appearance would be that of a room filled with smoke and lighted up by a candle. When a plate impervious to the rays is placed between a fluorescent screen and a source of the rays the platinocyanide of barium nevertheless becomes luminous, and this luminosity is visible even when the screen lies directly upon the plate. If, however, the screen placed on the plate is covered by a cylinder of lead 0.1 cm. in thickness surrounding the fluorescent screen the fluorescence disappears. Professor Röntgen has further been able to measure the intensity of the rays and to study the influences on which this depends. Dr. Brandes' observations that the X-rays may be made visible, presumably by causing fluorescence of the retina, are confirmed. Professor Röntgen sums up the present state of our knowledge in regard to the rays as follows: (1) The rays proceeding from the discharging apparatus are a mixture of rays varyin absorbability and intensity. (2) The composition depends chiefly on the duration of the discharging current. (3) Different bodies absorb different kinds of rays. (4) The X-rays are produced by the cathode rays and the phenomena of both are probably of the same nature.

THE compilation of the statistics of coal production in the United States in 1896, which has just been completed by Statistician E. W. Parker, of the U. S. Geological Survey, shows that the product in 1896 was 190,639,959 short tons, valued at $195,557,649, against 193,117,530 short tons, valued at $197,799,043 in 1895, a decrease of 2,477,571 short tons in amount, and of $2,241,394 in value. The decrease in product was entirely in that of Pennsylvania anthracite. The output of bituminous coal shows an increase of about one and three-quarters million tons. The anthracite product of Pennsylvania decreased nearly four and a quarter million tons. It is a notable feature, however, that there was a decrease in the value of the bituminous product of over $1,600,000, notwithstanding the increased output, and that there was a comparative increase in the value of anthracite, although, on account of the smaller production, it did not equal the value in 1895. The average price obtained for anthracite at the mines increased from $1.41 in 1895 to $1.51 in 1896. The average price for bituminous declined from 86 cents to 83 cents.

AT the coming International Leprosy Conference, to be held in Berlin on October 11th, Dr. Hutchinson, of London, will report on alimentation and leprosy; Professor Virchow on the pathological anatomy of leprosy; Dr. Neisser, of Breslau, on its origin; Dr. Bernier, of Paris, on its etiology, and Professor Koch will discuss the question of its infectiousness.

WE learn from *Natural Science* that the Natural History Museum of Halifax, which was handed over to the County Borough Council about eighteen months ago by the Literary and Philosophical Society, has now found a permanent home in the old mansion named Belle Vue. The geological and botanical collections are very extensive and valuable, but zoology is as yet very imperfectly represented. The herbarium has lately been much enriched by the fine Gibson collection of British plants, the gift of Lady Trevelyan. The Curator, Mr. Arthur Crabtree, is making an attempt to render the Museum of general educational value by adequate labelling, and wishes to secure a competent committee of management to direct and second his efforts.

UNIVERSITY AND EDUCATIONAL NEWS.

THE Supreme Court of New York State issued on July 6th its final decision in the Fayerweather will case. The executors were required to distribute within ten days the three million dollars in question to the twenty colleges to which they were bequeathed.

THE only colleges so far as we have noticed which have this year given the Ph. D. degree *causa honoris* are Union, Dartmouth and Tufts. These colleges have acted unwisely and Union College, as we understand it, illegally.

PROFESSOR WILLIAM A. ROGERS, who recently accepted the Babcock professorship of physics in Alfred University at Alfred, N. Y., delivered the principal address at the laying of the cornerstone of the Babcock Hall of Physics at Alfred on June 22d. The hall is named after the late George H. Babcock, of Plainfield, N. J., who left $100,000 to Alfred University.

AT the University of Indiana A. L. Foley, Ph. D. (Cornell), has been elected professor of physics; R. J. Aley, Ph. D. (Pennsylvania), professor of mathematics; E. B. Copeland, of the University of Wisconsin, assistant professor of botany, and E. B. Bryan, assistant professor of pedagogy.

HENRY C. MINTON, of San Francisco, was elected President of Centre College this week.

DR. G. J. PIERCE has been elected assistant professor of botany in Stanford University.

IN the newly organized high schools of New York City, as the result of a competitive examination, there have been appointed as first assistants, at a salary of $3000, Mr. Frank Rollins, chemistry; Mr. R. H. Cornish, physics, and Mr. E. W. Sampson, physical geography.

THE University of Strasburg has celebrated, by fêtes lasting several days, the 25th anniversary of its foundation.

PROFESSOR W. TH. ENGELMANN, of the University of Utrecht, has been offered the chair of physiology at Berlin, vacant by the death of Du Bois-Reymond, but it is stated that he will not accept. The position had previously been twice declined.

DR. JAEGER and Dr. Brodhun have been appointed professors at The Reichsanstalt at Charlottenburg; Dr. Ignaz Zakezewski has been made full professor of experimental physics at the University at Lemburg, and Dr. H. Finger, of Giessen, has been appointed assistant professor of organic chemistry at the Polytechnic Institute in Darmstadt.

DISCUSSION AND CORRESPONDENCE.

A BRILLIANT METEOR.

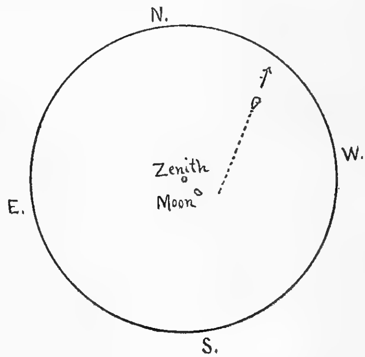
TO THE EDITOR OF SCIENCE: On June 22d a brilliant meteor was observed in broad daylight passing over Cape Breton Island, Nova Scotia. In order that some permanent record of the fact may exist, I beg to forward for publication a letter received from Mr. George Kennan, who was an eye-witness of the occurrence.

ALEXANDER GRAHAM BELL.

BEINN BHREAGH, NEAR BADDECK, C. B., NOVA SCOTIA, July 1, 1897.

Letter from Mr. George Kennan.

MY DEAR MR. BELL: I will gladly give you all the information I can in regard to the meteor. Between half-past eight and nine o'clock, Tuesday morning, June 22d, as I was going into my garden to work, a very large and extraordinarily bright meteor suddenly made its appearance nearly southwest of the zenith, at a height of about 70 degrees from the horizon and almost directly under the old waning moon. I happened at that time to be looking upward and westward, and I think I saw it at its place of origin—that is, at the point where it first became visible. It was not a mere point of light, like a brilliant star, but seemed to have a large, well-defined disc, resembling in shape a somewhat elongated and almost inverted balloon with its top or larger end foremost—that is, turned in the direction of its fall. It came into



the field of vision so near the waning moon that I was able to compare the one with the other in point of size, and the impression made upon my mind was that the disc of the meteor was nearly as large as the filled-out circle of the moon would have been. Of course, the eye unconsciously exaggerates the size of a brilliant object, and it probably did so in this case, but such was the impression made upon me, and I give it for what it may be worth. I don't think the meteor had any decided color. At any rate, all that I noticed was its extraordinary brilliancy. If it had been decidedly green, red,

or yellow, I think I should have become conscious of the fact. It seemed to be followed by a faint line of light about half as long as its own body. From a point about 20 degrees southwest of the zenith it fell rather swiftly in a direction that would have brought it to the horizon at a point very nearly northwest (magnetic) of my position. I was unable, however, to follow it all the way to the horizon on account of the trees between my house and your cottage behind which it disappeared without having lost either its shape or its brightness. The time occupied by its fall was not more, I think, than three seconds. If you will hold the accompanying diagram above your head like a celestial chart and look up at it, facing the west, you will get an approximate idea of of the meteor's course as it appeared to me. The sun was shining brightly, but it did not overcome the brilliancy of the aerolite.

Sincerely yours,

GEORGE KENNAN.

BRETON COTTAGE, BADDECK, C. B.,
NOVA SCOTIA, June 26, 1897.

SCIENTIFIC LITERATURE.

WHAT ARE STIPULES?

'THE Nature and Origin of Stipules,' by A. A. Tyler, A. M. Presented to the Faculty of Pure Science of Columbia University in partial requirement for the degree of Doctor of Philosophy. Annals of the New York Academy of Sciences, Vol. X., New York, 1897, pp. 1–49, pl. i.–iii. Also separate: Contributions from the Department of Botany of Columbia University, No. 119.

This is, without doubt, the most considerable contribution that has been made to the vexed question of the nature of stipules; at least it is safe to say that it comes much nearer to a solution of that question than anything that has hitherto been brought forward. Although assuredly not the last word that will be said on the subject, nevertheless the light that had already been shed upon it by a long train of previous investigations placed the author in a position to treat it from an advanced standpoint.

Nearly half the paper, and that the first half, is devoted to summing up, in chronological order, the views that have been expressed and the conclusions that have been reached; but the paper is by no means a mere literary effort. It is itself the result of a series of special researches on the part of the author. Indeed, it may be looked upon as a new departure, since his investigations have proceeded from an almost entirely different standpoint from those of previous authors. He has made use of their labors and failures rather as a means of warning than as guides to his work.

Probably the most suggestive results that had been reached were those which, within the past decade, have been furnished by paleontology, and while he has singularly omitted to mention the researches of Saporta and Marion,* he has not left out of account those that have been made in America.† It is not too much to say that these paleontological discoveries have added more to our acquaintance with the true nature of stipules than the combined morphological studies of previous authors. If I do not mistake, it was from attention to paleontological considerations as thus brought out, that Mr. Tyler was led to adopt the method of his thesis, a method which had been wholly neglected hitherto, and yet the only one that seems to promise ultimate success in the solution of the problem.

The earliest of the above mentioned papers called attention to certain remarkable basilar expansions that occur in leaves of *Platanus basilobata*, a fossil species from the Fort Union

* Evolution du Règne Végétal, Pt. II., Phanérogames. Paris, 1885. See especially Vol. I., pp. 201–223; Vol. II., pp. 9–44.

† The Paleontologic History of the Genus Platanus by Lester F. Ward; Proc. U. S. Nat. Mus., Vol. XI., 1888, pp. 39–42, pl. xvii.–xxii. Origin of the Plane-Trees, by Lester F. Ward; Am. Nat., Vol. XXIV., September, 1890, pp. 797–810, pl. xxviii. Flora of the Dakota Group, by Leo Lesquereux; Monogr. U. S. Geol. Surv., Vol. XVII., pp. 65, 231, 232, 254. Wing-like Appendages on the Petioles of *Liriophyllum populoides* Lesq. and *Liriodendron alatum* Newb., with Descriptions of the Latter, by Arthur Hollick; Bull. Torr. Bot. Club, Vol. XXI., No. 11, November 24, 1894, pp. 467–471, pl. ccxx., ccxxi. Appendages to the Petioles of Liriodendra, by Arthur Hollick; Bull. Torr. Bot. Club, Vol. XXIII., No. 6, June, 1896, pp. 249–250, pl. cclxix., cclxx.

group, which was compared with another fossil species, *P. appendiculata* of Lesquereux, in which somewhat similar basilar expansions occur, but in this case separate from the main blade. The latter species comes from the Auriferous gravels of California, a much later formation, and it was argued that these two cases indicate a gradual separation of these lobes from the blade as having taken place in the progress of development. It was further shown that the living American species, *P. occidentalis*, sometimes has a small expansion at the base, through which the petiole passes, and that other cases may be found on young shoots in which these lobes are distinct from the blade.

The second paper cited, though chiefly a criticism of a memoir by Jankó, on the leaves of Platanus, discusses the subject of basilar expansions with additional illustrations.

Dr. Hollick's papers deal with an almost similar condition of things in the fossil species of Liriodendron. Both of these genera belong to what are known as waning types, and their present foliage has reached its highest state of development.

These and other facts that have been from time to time coming to light had begun to imbue botanists who had given attention to the subject with the general idea that stipules are morphologically portions of the leaf that have been gradually separated from the existing leaf blade through a process of development going on under the influence of the great principle of advantage in biology, which relegates to the domain of vestiges or obsolescent organs everything that has ceased to benefit the organism, a process which has as its ultimate result the complete extinction of such organs, and there is no doubt that in many cases modern exstipulate leaves have once had stipules and lost them, although it is also true, as Mr. Tyler shows, that in other cases, especially those of sessile leaves, no stipules have ever existed.

In 1894 Mr. Morong, in treating the genus Smilax,* said: "Most of the species climb upon other shrubs and trees by means of a pair of tendrils which grow at the summit of a stipular wing on each side of the petiole, often not developing till the stem is several years of age;" to which he adds in a footnote: "De Candolle regards this appendage as more in the nature of a modified leaf segment or leaflet than a stipule, but it seems to me that a stipule is nothing else than a leaflet at the base of a petiole." Mr. Tyler does not note this statement of Mr. Morong in his bibliographic summary, but it is characteristic both of Mr. Morong's keen insight into such matters and also of the general drift of botanical thought on the subject.

* Bull. Torr. Bot. Club, Vol. XXI., No. 9, September 29, 1894, p. 420.

In the paper before us there are brought out into clear light at least three distinct and highly important facts. The first relates to method. It had long been felt that the great need in botany was the study of plants from the embryological standpoint in some such way as animals have been studied with such remarkable results. The two great sources of our knowledge of development in both kingdoms are, first, paleontology, and second, embryology. Both of these had been almost totally neglected by botanists until within recent years. Something, it is true, had been done along the more general lines of plant development from the paleontological side, but scarcely anything in connection with the transformation that leaves undergo, and the few papers above quoted constitute practically all that has been done in this line. A number of attempts have, however, been made to approach the vegetable kingdom from the embryological point of view. But the seed being regarded in a certain sense as the homologue of the egg, most of these attempts have been devoted to the study of the seed and of seedlings, the great work of Sir John Lubbock constituting the most exhaustive of these efforts.

Mr. Tyler has shown in the present paper that the study of plant embryology should not proceed from a consideration of seeds and their development, but of buds, and that while botanists have been mainly seeking for light in the difficult study of seed embryos, the true source of such knowledge is the much more accessible phenomena of bud development. The figures that he has given abundantly demonstrate this truth, and henceforth there can be no doubt that botanists generally will proceed according to this method and that the

natural history of the leaf will soon be fully known.

The second lesson which Mr. Tyler's paper enforces is the one which paleontology, as we have seen, had already taught. What the leaf struggles to secure is the maximum amount of light and air. In this effort it constantly tends to stretch out as far a possible from the stem. The proximal portion, which is most shaded, is then sacrificed to the distal portion, and the leaf is differentiated into petiole and blade. But in this process various stages occur. Those parts which are of any advantage to the plant are in part retained, and the parts sacrificed are selected in the exact measure of their failure to benefit the plant.

Some may regard the principle of adaptation for securing the maximum light and air as inadequate to explain these modifications of the leaf, but it is this principle that determines not only the form but also the arrangement of leaves, and when we remember that opposite leaves are also decussate, that in whorled leaves those of one whorl stand over the intervals between those of the next whorl below, and that even in plants with alternate leaves the phyllotaxy is so adjusted as to secure the longest interval between one leaf and the next one that must stand directly over it, we not only see with what rigorous exactness this principle works, but also what apparently trifling differences in advantageousness are seized upon and made to count in producing manifest effects.

The least useful portion of a leaf is not that at the very base, but that which is some distance from the base, and even this may be partially retained as a wing to strengthen the leafstalk. The portion at the base is often preserved in one form or another, and we have seen, in the fossil and living species considered, how this may vary in the process of evolution, but in the most highly developed of our living flora, where it is retained at all, it is usually in the form of stipules, which have all conceivable shapes and differ in all degrees in their permanence, some being appropriated to other uses according to the law of vicarious function. Others are persistent as small organs of different forms. Still others are deciduous at varying stages in the growth of the leaf, some, as Mr. Tyler shows, never being seen except on dissecting the bud. The last stage in this process is their complete atrophy and the resultant wholly exstipulate leaf.

The third lesson that we learn from Mr. Tyler's studies is that monocotyledonous plants constitute an early stage in the process of leaf development. This is what would have been naturally supposed, but there has been a tendency of late to cast doubts upon the position of the monocotyledons and to maintain that they are as highly developed and that they have been as late in their appearance in geologic time as the dicotyledonous angiosperms. It must be admitted that the paleobotanists have been the ones who have chiefly taken this view. This has been due to the exceedingly meager representation which the monocotyledons have in the fossil floras of the globe, and especially to the natural doubts which have arisen as to the botanical character of most of the fossil forms that have been regarded as monocotyledons by certain authors. The Yuccites of Schimper, from the Lower Trias, as also his genus *Ætho-phyllum*, which he did not himself refer to that class, but which others have naturally regarded as a monocotyledonous plant, cannot certainly be claimed as ancestral monocotyledons, although the proof to the contrary is equally wanting. Scarcely anything that has been discovered in the great Jurassic floras of the world has even been called monocotyledonous, and very little that is certainly such occurs even in the Cretaceous. It is, therefore, been held by some that this class of plants first made its appearance with the palms of the Eocene, but so rich and varied is this Eocene palm flora that it presents a case analogous to that which until recently was offered by the dicotyledonous floras of the Middle Cretaceous, and requires the violent assumption that a great group of plants suddenly burst in upon the world and attained all at once a high state of development in widely separated regions. This assumption is now thoroughly disproved in regard to the dicotyledons by the discovery of early embryonic types at a much earlier age, naturally leading up to the higher types referred to.

The monocotyledons, from their very nature, are the least adapted of all forms of vegetable

life to be preserved in the fossil state, representing, as Saporta and Marion show, and as Mr. Tyler's researches fully bear out, the primitive form of leaf development, which consists simply in setting apart a portion of the growing plant to serve the purposes of leaves, consisting of more or less broad and elongated blades, usually embracing the stem and tapering gradually to a point, with the leaf bundles continued in straight lines parallel to each other throughout their entire length. They are, therefore, broadest at the base and least adapted to securing the ultimate purpose of leaves already mentioned, viz., the maximum amount of light and air. The process of leaf development began with this condition, and many of the forms in which the cotyledon is still single have acquired a blade, as, for example, many species of *Potamogeton*, *Smilax*, *Dioscorea*, etc. In *Smilax* and some other genera true stipules have been developed, along with the tendency towards their differentiation into tendrils and other useful organs.

An important obstacle to the preservation of monocotyledonous leaves in the fossil state is the absence in them of any definite joint or natural point of separation of the leaf from the stem, which is one of the earliest results in the process of leaf evolution, also involving the principle of the renewal of leaves at annual or other fixed periods, which has practically resulted in the indefinite multiplication of the leaves produced, increasing the chances of their preservation by the whole number of such renewals. The only chance for an ordinary monocotyledonous plant to become entombed and preserved in the fossil state is that the locality in which it grows shall become somewhat rapidly covered up, burying the entire plant so quickly that it cannot decay during the process. This, as anyone can see, must be an exceedingly rare occurrence. Still, there is no doubt that a large amount of monocotyledonous vegetation growing in bogs and marshes in estuarine regions that are slowly subsiding under the weight of materials brought down the streams, and which also aid in covering them up, has been, in fact, preserved in a very imperfect way, and many vague and puzzling objects occur in all collections made from such localities. They are found throughout the Mesozoic, in the form of short culm-like segments and imperfect bits of leaves so badly macerated that they are neglected by those who determine such collections. It is rarely possible to say what form of plant they really represent, and yet it is often clear that these remains belong to certain glumaceous forms, grasses, sedges, rushes, etc. Saporta, in his work on the Mesozoic of Portugal, described and figured, under the name of Poacites, quite a number of these forms from the Neo-Jurassic to the Albian, or through the Upper Jurassic and entire Lower Cretaceous. Others have been called Cyperites, Zosterites, Bambusium, etc. Numerous small seeds are also constantly occurring, which are for the most part unnamed or given such names as do not indicate their botanical affinities. Many of these probably belong to monocotyledonous plants.

Mr. Tyler's paper, with all its excellencies, conveys the impression of an unfinished production. One would say that in his hurry to use it as a thesis he had been obliged to close it up abruptly. Its most serious defect is the want of careful descriptions of the plates and figures explained in their numerical order for the convenient use of the reader. This condition of the paper suggests the probability that the writer has much additional material, and inspires the hope that he may have entered upon a much more extended and exhaustive series of observations along these suggestive lines.

LESTER F. WARD.

On the Genera of Rodents: An Attempt to bring up to Date the current Arrangement of the Order. By OLDFIELD THOMAS, F.Z.S. Proc. Zool. Soc., London, 1896, pp. 1012–1028. Issued April, 1897.

The order Rodentia offers peculiar difficulties to the student, both on account of the number of its species and the great variety of forms which it includes. The satisfactory arrangement of the thousand or more species now known is no easy matter, as shown by the attempts of several authors, notably Waterhouse in 1839–48, Gervais in 1848–53, Brandt in 1855, Lilljeborg in 1866, Gill in 1872, and Alston in 1876. During the last ten years more progress has been made in the study of mammals than

in any previous quarter of a century. New methods of collecting, and more thorough exploration of regions previously little known, have brought to light a host of new forms and furnished material for studies which have thrown new light on the relationship of many groups. More careful examination of the literature has likewise necessitated many changes in nomenclature. Thus it is not surprising that Alston's classification, which has been generally adopted during the last 20 years, should have become somewhat antiquated.

In many respects Mr. Thomas is peculiarly fitted for the task of 'bringing the arrangement of the order up to date.' As curator of mammals in the British Museum he has constant access to a collection of rodents, which includes representatives of all but 15 of the existing genera and is unrivalled in the possession of a large number of types. Perhaps no other zoologist is personally familiar with more species or has a better general knowledge of the Rodentia than Mr. Thomas. He has also done much towards placing the nomenclature on a sound basis and has kept fully abreast of recent morphological work.

Although his paper comprises only 16 pages, it is an unusually important contribution to the literature of mammals and its value is not to be measured merely by its length. Unlike Alston's paper, it contains no diagnoses, and is therefore merely a list of genera arranged by families and subfamilies. It is intended mainly as a convenient reference list for museum curators and writers who have neither the time nor the inclination to work out the relationships of genera. Its object is threefold, since it gives: (1) the position and sequence of the genera in their respective subfamilies; (2) the earliest available name for each genus, and (3) a reference to the original description. The results of the investigation here presented necessitated not only a study of the genera and families, but the selection of the proper name from a host of synonyms for each of the 160 groups which are considered worthy of generic rank.

It would have been very desirable if the list had included extinct as well as living forms and had been extended to subgenera, thus forming a complete conspectus of the order. In limiting it to living mammals the author restricted himself to forms with which he is personally familiar, and by omitting subgenera avoided a vast amount of work which would have inevitably delayed the appearance of the list.

The changes which have been made in the classification of Rodents during the last 25 years can be most clearly brought out by comparing the lists of Gill, Alston and Thomas, but in so doing it should be remembered that Thomas follows Alston as closely as possible in the arrangement of the higher groups. Gill in 1872 recognized 9 superfamilies, 20 families, 16 subfamilies, but mentioned no genera; Alston in 1876 gave 3 superfamilies, 18 families, 23 subfamilies and 100 genera; Thomas now admits 5 superfamilies, 21 families, 27 subfamilies and 161 genera.* The increase in the present list is due to elevating the Bathyergidæ, Heteromyidæ, Erethizontidæ and Pedetidæ to the rank of families, and reducing the Lophiomyidæ to a subfamily of Muridæ. About one half the additional genera are 'new discoveries' and the remainder are due to the breaking-up of old genera.

Recent writers divide the Rodentia into two suborders: Simplicidentata and Duplicidentata; and most of them have followed Alston's tripartite division of the Simplicidentata into Sciuromorpha, Myomorpha and Hystricomorpha. This simple arrangement has not proved satisfactory, since some of the outlying genera will not fit into either group. To meet this difficulty Thomas has added two groups: Anomaluri and Aplodontiæ, making 5 subdivisions of superfamily value, thus to some extent following Gill. But in the attempt to retain Alston's higher groups with the termination *morpha* and at the same time to distinguish others of lower rank he has introduced two subdivisions between family and suborder. The names adopted are unfortunate, since the terminations are not distinctive, having been used by different authors for divisions varying in rank from superfamilies to subgenera. It would be simpler to

*Only 159 are mentioned, but *Fiber* is inadvertently omitted, and *Chilomys* has been proposed since this paper was printed. Beside these *Sigmodontomys* and *Zygodontomys* have recently been described by Dr. J. A. Allen.

adopt Gill's termination *oidea* for all these groups, although such a course would reduce the Sciuromorpha to the same rank as the Anomaluridæ. The relation of Thomas' superfamilies to those of Gill and Alston is as follows:

Anomaluri=Alston's Anomaluridæ=Gill's Anomaluroidea.

Sciuromorpha=Alston's Sciuromorphia (minus the Anomaluridæ and Aplodontiæ=Gill's Sciuroidea+Castoroidea.

Aplodontiæ=Alston's Haplodontidæ = Gill's Haploodontoidea.

Myomorpha=Alston's Myomorpha=Gill's Lophiomyoidea + Myoidea + Myoxoidea+Saccomyoidea.

Hystricomorpha=Alston's Hystricomorpha =Gill's Hystricoidea.

Two of Thomas' subfamily names, Loncherinæ and Sigmodontinæ are open to question on grounds of priority. The Loncherinæ were separated as a distinct group by Burmeister in 1854, but Gray had previously recognized the subfamily Echimyna in 1825, and Gill adopted the name in the form Echimyinæ in 1872. *Echimys* and *Loncheres* both belong to the same subfamily, and Echimyinæ besides being more generally used than Loncherinæ has several years' priority. Sigmodontinæ must give way to the well-known term Cricetinæ, the change having been made through a misapprehension as to the validity of the generic name *Cricetus*. As will be shown further on, there is no reason for rejecting *Cricetus* or the subfamily of which it is the type.

The instability of generic names is strikingly exemplified by this list. No less than one-eighth of the genera have been 'changed' during recent years, and in the attempt to find names which have unquestioned priority and are not preoccupied, the author has introduced unfamiliar terms for about 10 per cent. of the genera. In all such cases, however, the commonly accepted designations are added in brackets. But it may be questioned whether he has really carried this work far enough, for several of the names left undisturbed are open to objection.

Arctomys, which is usually credited to Schreber, 1792, can be traced back to 1780, but even with this early date it will probably have to give way to *Marmota* Blumenbach, 1779. The latter appeared in the first edition of the Handbuch d. Naturgeschichte—a rare volume, which is not accessible at present, and hence it is impossible to ascertain what species were originally placed in the genus.*

Hamster Lacépède appeared in 1801, whereas *Cricetus* was described by Cuvier in 1798, although not named until 1800. It was, however, defined by Kerr in 1792, and therefore antedates *Hamster* by not less than nine years. This is an excellent illustration of the importance of ascertaining the first publication of a name. Quoting *Cricetus* from Cuvier, Thomas assumes it to date from 1817 and rejects it in favor of *Hamster*, 1801. Had he found Cuvier's first use of the *Cricetus* in 1800 he would have avoided changing a name which must now be restored.

Cœlogenus Cuvier, 1807, appeared six years later than Lacépède's *Agouti*, the latter having been published in the Mem. de l'Institut, Paris, III., p. 494, 1801. As both of these genera were based on the same animal, *Agouti paca* (Linn.) is the proper name for the common paca.

Lagostomus Brookes, 1829, is antedated by *Vizcacia* Schinz, 1824,† and should be replaced by it.

Ellobius Fischer, 1814, may be considered untenable by some zoologists because of the prior use of *Ellobium* by Bolten in 1798 for a genus of mollusks,‡ but those who reject *Ellobius* must find a substitute for it, probably in *Chthonoergus* Nordmann, 1839.

The references to the original description of each genus in the list will be found very useful, but in a number of cases the names were actually published from one to twelve years

*In the 7th edition of the same work, published in 1803, Blumenbach included *Marmota alpina*, *M. cricetus*. *M. lemmus*, *M. typhlus* and *M. capensis*.

†See SCIENCE, New Ser., VI., July 2, 1897, pp. 21–22.

‡Museum Boltenianum, 1798. See Adams, Gen. Recent Moll., II., 1858, p. 237. Both names are derived from the same Greek word, the neuter noun ἐλλόβιον, an ear ring. Should it be desirable to place the mammal genus in a separate subfamily, as Gill has already done, the designation Ellobiinæ becomes identical with that in use for a subfamily of mollusks.

earlier than here indicated. The author could hardly be expected to verify all his references and had he done so the result might not have justified the labor. Nevertheless, the failure to find the original description may result in an error which will necessitate a change in the type of a group or may even lead to the rejection of a valid current name as in the case of *Cricetus*. As Mr. Thomas has evidently given merely the references usually quoted by authors, the remarks on this part of the paper should be regarded as supplementary notes rather than criticisms. For the benefit of those who may use the list, the earliest references are given below for genera which were published before the dates assigned by Thomas:*

9. *Arctomys* Schreber, Säugthiere, plates CCVII.–CCIX.,1780, text IV., pp. 721–743, 1782 (not '1792').

16. [*Myoxus* Schreber, Säugthiere, IV., plates CCXXV. A–B, CCXXVII., 1782, text IV., pp. 824–831, 1787] (not '1792').

19. *Graphiurus* F. Cuvier, Proc. Zool. Soc. London, p. 5, July, 1838 (not '1845').

31. *Rhombomys* Wagner, Gelehrte Anzeige K. Bay. Akad. Wiss. München, XII., pp. 421, 429, 433, March, 1841 (not '1843').

35. *Dendromus* A. Smith, Zool. Journ., IV., pp. 438–439, Jan.–May, 1829 (not '1834').

61. *Cricetus* Kerr, Anim. Kingd., I, Mamm., pp. 42, 242–246, 1792 (not Cuvier, '1817').

72. *Rhipidomys* (Wagner), Tschudi in Wiegm. Archiv. 1844, I., p. 252 (not '1845').

96. [*Cuniculus* Wagler, Nat. Syst. Amphibien, p. 21, 1830] (not '1832').

— *Fiber* G. Cuvier (Tableau Elem. d'Hist. Nat. Anim., p. 141, 1798), Lecons d'Anat. Comp., I., Tabl. 1, 1800.

100. *Tachyoryctes* Rüppell, Neue Wirbelthiere z. Fauna von Abyssinien, Säugth., pp. 35–37, Taf. 12, 1835.

108. *Heteromys* Desmarest, Nouv. Dict. d' Hist. Nat., 2d ed., XIV., pp. 180–181, 1817 (not '1822').

115. *Dipus* Schreber, Säugthiere, pls. CCXXVIII.–CCXXXII., 1782, text IV., pp. 842–861, 1788–89 (not 'Gmelin, 1788').†

137. *Echimys* Cuvier, Nouv. Bull. Soc. Philom., p. 394, Sept., 1809 (not '*Echinomys* Desmarest, 1817').

155. *Dolichotis* Desmarest, Journ. de Phys., LXXXVIII., p. 211, March, 1819 (not '1822').

But however desirable it may be to obtain the earliest reference, a generic name can not date farther back than 1758 (the year when the 10th edition of Linnæus' Systema Naturæ was published) or before the time when it was used as a scientific and not a vernacular name. Brisson's genera of 1756 must date from 1762, and French names should not take precedence over others published later, but before the former appeared as Latin names. The following genera should therefore be quoted as indicated below:

Spermophilus Cuvier, Dents des Mamm., 1825, pp. 160–161, 255, pl. LV. (not 1822), *Glis* Brisson, Regn. Animale, ed. 2, 1762, pp. 13, 113–118 (not 1756); *Atherurus* F. Cuvier, Dict. Sci. Nat., LIX., 1829, p. 483 (not G. Cuvier, Règne Animal, 1829); *Cercolabes*, Brandt, 1835, Mem. Acad. Imp. Sci. St. Petersburg, 3d ser., III., pp. 55–58 (not F. Cuvier, 1822); *Hydrochœrus* Brisson, Reg. Animale, 1762, pp. 12, 80–81 (not 1756).

Neither should the *apparent* date of publication be accepted when there is evidence to show that the name actually appeared earlier or later than indicated by the title page of the volume in which it was printed. For this reason *Anomalurus* should date from January, 1843, not 1842; *Psammomys* 1828, not 1826; *Oreinomys* 1881, not 1880; *Saccostomus* 1846, not 1847; *Acomys* 1838, not 1840; *Chiropodomys* 1868, not 1869; *Zapus* 1875, not 1873; *Pectinator* 1856, not 1855; *Schizodon* March, 1842, not 1841; *Chætomys* 1843, not 1848; *Lagostomus* 1829, not 1828. This question of exact dates may seem a very trivial matter, but when a difference of only a year or two in publication has necessitated the rejection of such well known names as *Arvicola*, *Isomys* and *Ochetodon*, it can readily be seen that, unless the date of publication is fixed with precision, generic names will never be stable.

*To these may be added *Fiber*, omitted from the list, and *Tachyoryctes*, which has no reference.

† Those who agree with Sherborn in not recognizing names on plates must quote *Dipus* from Boddaert's Elenchus Animalium, 1785, p. 47. In either case the authority is not Gmelin, as given by Thomas.

In two minor points the list is fairly open to criticism, namely, in the abbreviation of authorities and references, and in the emendation of names. Even those familiar with the literature will find difficulty in recognizing Ogilby in 'Og.,' Brants in 'Bts.,' Hemprich and Ehrenberg in 'H. & E.,' or in telling whether 'Sm.' stands for Smith or Smuts. In most cases Mr. Thomas has followed the original spelling of a name, but apparently with some hesitation, for he finds it necessary to apologize for *Aplodontia*, stating that he looks 'with loathing on these h-less names.' He has, however, adopted the emended forms *Echinomys* for *Echimys*, *Cannabateomys* for *Kannabateomys*, *Pithecochirus* for *Pithecheir*, and *Acodon* for *Akodon*, although in a paper subsequently published he has reverted to the original spelling, *Akodon*.

There is opportunity for much divergence of opinion as to the sequence and relative rank of the groups, for example, as to the wisdom of reducing the Lophiomyidæ to a subfamily of the Muridæ, while giving *Pedetes* and the American Porcupines full family rank. Some may question the removal of the Batherginæ from the Spalacidæ to form a separate family placed after the Geomyidæ and Heteromyidæ, so that the Old World genera *Spalax* and *Bathyergus*, which were formerly arranged side by side, are now separated by two families of New World pouched gophers and pocket mice: Possibly, it may seem that the author has recognized a relatively large number of genera of Muridæ, in view of the statement that all the recently proposed genera of Geomyidæ "may be most conveniently treated as of subgeneric rather than generic rank, sound as their basis as natural groups no doubt is."

But whatever difference there may be in regard to minor points, the fact remains that this paper admirably fulfills its purpose as a check list of genera of Rodents. We may venture to hope that the field having now been cleared to a certain extent of nomenclatural difficulties, Mr. Thomas will soon undertake the work which has so long been needed, namely, a complete catalogue of the Rodentia.

T. S. PALMER.

WASHINGTON, D. C.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES—BIOLOGICAL SECTION, APRIL 5.

PROFESSOR OSBORN moved that a committee be appointed to consider and take action on the question of postage on natural history specimens. The chair appointed Doctors Dyar and Dean and Professor Stratford. Professor Bristol offered his resignation as Secretary. It was accepted, and the election of his successor was laid over until the next meeting.

Professor Osborn reported upon the phylogeny of the early Eocene Titanotheres, showing that they are divided into two distinct series, included under the genera *Telmatotherium* and *Palæosyops*, both of which independently acquired horns. The Telmatothere line begins with *T. boreale*, a form which Cope referred to as Palæosyops. It is distinguished by animals with long narrow skulls and high stilted feet, and undoubtedly represented the upland types of the family. The Palæosyops line, as suggested by Earle and Hatcher, passes through *P. laticeps* and *P. manteoceras*, and leads up to Diplacodon, the larger species of which surpass in size the smaller Titanotheres of the Oligocene. The main line gives off several collaterals, such as *P. paludosus*. Lambdotherium does not belong in the Titanothere phylum at all.

A second note related to a division of the two groups of placental mammals, the Meseutheria and Ceneutheria. The former, since Wortman's demonstration that the Ganodonta are ancestral Edentates, must now embrace this division, besides the Creodonta, Lemuroidea, Tillodontia, Insectivora, Amblypoda and Condylarthra.

The third note related to the origin of the typical mammalian types of teeth among the Theriodonta, Cynodontia and Gomphodontia of the Triassic. It is especially noteworthy that the Gomphodontia afford a demonstration of the origin of multituberculate teeth from a tritubercculate ground plan, as hypothetically assumed by the speaker some years ago.

Mr. Bradney B. Griffin reported that in Thalassema (one of the Echiurids) the spireme occurs in minute ova (3 micra in diameter) floating in clusters in the body cavity. The spireme segments into one-half the somatic

number of chromosomes, which by partial longitudinal splitting pass into flattened ellipses. These elongate, and during the growth period become twisted and distorted, and their true shape is thereby obscured. While entering the first polar spindle they appear as loose open rings or compact rods (bivalent). These by concentration and looping up form crosses, opposite arms of which are attached to the 'Zugfasern.' During metaphase the crosses become drawn ont into flattened ellipses which split across into two V's with closely apposed limbs. At telophase the latter separate at the angle and diverge in the second polar mitosis. No longitudinal splitting of the V's occurs.

In Zirphæa (Lamellibranch) the process is identical, although more obvious by reason of the less close apposition of the halves of the rings and V's. The conclusion is that in both forms a reducing division takes place.

Mr. J. H. McGregor offered a preliminary report on the development of the Spermatozoa in Amphiuma. Professor F. E. Lloyd's paper on Pholadidæa of the Pacific Coast was read by title.

C. L. BRISTOL,
Secretary.

MAY 3, 1897.

Mr. Gary N. Calkins, of Columbia University, was elected Secretary of the Section.

In the absence of Dr. Dyar, chairman of the committee appointed to consider the question of postage on natural history specimens, Professor Stratford reported that the Postmaster-General had been notified, and that the matter had received due consideration.

Upon behalf of the committee appointed to draw up a resolution relating to the death of Professor Cope, Professor Osborn delivered a brief eulogy of the great naturalist, pointing out the especial features which have made his work famous and have given him such a high position in the history of natural science. He dwelt especially upon the fact that Professor Cope prosecuted five great lines of work simultaneously, and that in each he acquired a commanding position. He also spoke of some of his generous qualities as a fellow scientific worker, especially his liberality in the loan of collections and generous recognition of the work of others. Finally, he alluded to his remarkable independence and fortitude of character, and persistent devotion to science, even with limited resources. His death leaves a vacuum especially in the line of able and accurate criticism of contemporary work. Professor Osborn concluded by submitting the following resolution:

The members of the New York Academy of Sciences desire to record their admiration of the noble services to science of the late Professor Edward D. Cope. Since 1895, when he offered his first contribution to the Philadelphia Academy of Sciences, at the age of nineteen, he has been a devoted and brilliant investigator in five great branches of natural history—ichthyology, herpetology of the batrachians and reptiles, mammalian paleontology, historical geology and philosophy. In each he has long been an acknowledged leader, and his combined knowledge of all has given his researches a philosophical breadth, grasp and permanence which place him among the great masters of comparative anatomy—Cuvier, Owen and Huxley. We deeply regret that his untimely death has cut short his life work, and feel that the loss of his keen, critical and productive faculty deals a blow to the cause of comparative anatomy of the vertebrata throughout the world, which can hardly be measured. We tender to the American Philosophical Society and to the Academy of Natural Sciences of Philadelphia, of which Professor Cope was a life-long member, an expression of our deep regret at their loss, and of our readiness to cooperate with them in the establishment of some suitable memorial.

Signed: HENRY F. OSBORN.
J. L. WORTMAN.

Mr. H. E. Crampton, Jr., gave a brief abstract of a paper by F. C. Baker on 'Notes on Variations in the apex of Gasteropod Molluscs.' Professor Bashford Dean and Mr. F. P. Sumner reported on the spawning habits of *Petromyzon Wilderi* at Van Cortlandt Pond. Mr. H. E. Crampton, Jr., reported on some Coalescence Experiments with Lepidoptera. A paper on the 'Vertical Distribution of Plankton in Deep-Sea Collections from Puget Sound,' by Professor James I. Peck and N. R. Harrington, was read by title.

G. N. CALKINS,
Secretary.

SCIENCE

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FRIDAY, JULY 23, 1897.

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*PHYSICAL ANTHROPOLOGY.**

PHYSICAL anthropology is that branch of the broader field of anthropology which treats of physical man. It has nothing to do with man as a social being; it is not concerned with the products of his hands or of his brain; it deals neither with technology, language, government, law, sociology, folk-lore nor religion; it treats of man as an animal.

We may for the sake of convenience consider four views of the subject. These are: (a) the scope of physical anthropology; (b) the problems of physical anthropology; (c) physical anthropology in its relation to museum exhibition; and (d) the importance or value of physical anthropology.

(a) *The Scope of Physical Anthropology.*

Physical anthropology assumes that man is an animal; is a member of the brute world, and it follows that man is to be studied as other animals are studied. It is then a part of zoology, which has for its study the entire animal world; and in this world man demands the most attention and the closet scrutiny, for he is both the most important and the most widely distributed of all animals. Applying the methods of zoological investigation to man, physical anthropology asks of his ancestry, of the time of his appearance on earth, of his kinds or varieties or species, of the comparative fertility of races, of the fertility of hybrids, of the laws of heredity and descent, and of the nature and influence of food, climate and environment upon man, and finally of man's relation to other animals.

* A lecture delivered at the Field Columbian Museum, March 20, 1897.

It becomes evident at once that in the various investigations which are instituted in the study of physical man we must have the assistance of other studies which are closely related. Thus by the aid of paleontology we may hope for light on the problem of man's first appearance, both in time and place, and also on the problem of man's ancestors, for paleontology is simply the study of zoology in geological times; it is the archaeology of zoology. Again, by the aid of embryology, we may hope to learn something of man's origin, for it is one of the laws of biology that the developmental history of the individual is an epitome of the developmental history of the race. With the aid of anatomy, the study of gross structure, we are able to compare the varieties of men and so classification and division become possible, and by means of comparative anatomy we can compare man's structure with that of other animals and thus learn of relationships. With the aid of physiology and experimental psychology we are enabled to judge of the comparative physical functions and mental activities of the different races. It must be added that no one or even all of these studies combined is physical anthropology. The data which they severally and collectively furnish make possible the broader, more comprehensive study of physical man.

It is well also that we remind ourselves that the study of physical anthropology has only recently become a possibility. The time was not so very long ago when man rebelled at the thought that he had anything in common with the animals; he forgot or overlooked the fact that his entry into and exit from this world were like other animals, that his life was and is a struggle for existence, that his physical nature was so like that of animals that the same laws of evolution which produced the one must have produced the other, must have produced all, must govern all. And so the skeptics of the scientific and unscientific world cried: Produce your missing link! The 'missing link' is dead, and almost forgotten, but in his stead has arisen, from the study of paleontology, embryology and comparative anatomy, an array of facts which unite man to the animal world in a manner so close and intimate as to admit of no questioning. As one anatomist* says: "Blood relationship and not some unknown plan of creation forms the invisible bond which unites organisms in various degrees of similarity, and in this great family man must find his place. He forms but a link in the chain, and has no right to consider himself an exception."

It may seem strange that after physical anthropology has been declared to be that part of zoology which deals with man that there should be any need to speak of the *methods* which are essential to its proper study. But the field offers such large opportunities for superficial work, and so much of that sort has been done that we may well devote a few minutes to the consideration of this subject. We hear so much of 'reversions,' 'simian traits' and 'anthropoid characters' that we are bewildered, and after all the evidence is in we can only conclude that man's ancestors were wonderfully and fearfully made. There is, indeed, in the different races of men, or in any one of them, an enormous amount of variation. A naturalist† asks: "Are not Esquimaux and Bushmen, Samoyedes and Australians, American Indians and Fantis much further apart than any two species of monkeys, of larks or butterflies?" While an anatomist,‡ speaking of the shoulder-blade, says: "I do not know what range of

* Wiedersheim: Structure of Man, p. 2.

† Sir Henry Haworth: *Natural Science*, Sept., 1896, p. 185.

‡ Professor T. Dwight: The Range and Significance of Variation in the Human Skeleton. Boston, 1894, p. 23.

variation a great series of the scapulæ of the larger felidæ might present, but a small one shows nothing like that of the human race, and I might even add that of the Caucasian."

But because certain parts of man's skeleton bear close resemblance to the gorilla, other parts to the chimpanzee, still others to the orang and gibbon, does it follow that man, in his race history, has been successively a gibbon, an orang, a chimpanzee and a gorilla? Surely it would seem no one would claim for man such a pedigree as this, but this has been done, if not openly, it at least has been tacitly implied. And hence the need of definite scientific methods which make such reasoning impossible. Naturally, all the methods of zoological investigation are not applicable in the study of the human species, but at least two are of the utmost value; they are the statistical, or mathematical, and the morphological. The use of the statistical method in anthropology, and its extension in zoology, is due very largely to Mr. Francis Galton. Its basis is an application of the laws of chance, and Galton has devised special apparatus to illustrate its application. The method is of great value in comparative studies, such, for example, as the various indices, which are determined from measurements on the skull. Thus, if we take the length of the skull in a thousand individuals, and arrange the results according to their distribution, we shall have a curve, the character of which will be determined by the uniformity of the individuals measured. If they are all of one race, and that race is free from admixture with other races, we shall expect to find a curve which is high in the center and of a uniform character. If, on the other hand, the race is a mixed one the curve will be broad in proportion to its height and will be irregular in its course. In other words, the character of the curve is largely determined by the number of disturbing causes. Just as in Galton's apparatus, the character of the curve described by shot which falls upon a compartment, striking in its passage pins, will be determined by the height from which it falls and the number of pins it encounters in its passage. By means of these curves, that is, by the use of the statistical method, the greater part of anthropometric investigations are shown.

In the second method, the morphological, we deal with form and arrangement, and the unit is not the individual, but the species. The method proceeds by homology and it recognizes in variation an indication of the slow modification of the race or species. In other words, morphology is simply an extension of comparative anatomy. It calls to its aid embryology and histology, or the study of minute structure. A character which appears occasionally in man and is always present in the apes is not to be called 'simian' until its pedigree has been carefully determined and it can be shown to have been a transmitted character or an actual reversion. A close adherence to the methods of morphology may not unravel all the problems which are presented in man's strucure, but it will make impossible many of the so-called deductions which thus far have been put forth in the name of physical anthropology.

(b) *Problems of Physical Anthropology.*

We have to consider in this place not so much what has been done as what remains to be done, for, although much has been accomplished, the field of investigation still remains very broad. In the first place, we do not yet know the exact lines of man's descent. His cousins are pretty well known, but his immediate ancestors are not yet discovered. There is yet to be learned even the approximate time of man's appearance *as man* upon earth. That time has been stated within the last year by one writer to

have been 15,000 years ago, by another to have been 200,000 years ago. The extreme antiquity of man's appearance is no longer questioned, for in Europe his remains have been found associated with the bones of long extinct mammals. Further evidence of his great antiquity has been found in Africa, Asia and America, and only recently remains have been found in Java which have up to this time defied the best anatomists of Europe to determine whether they belong to man or to some extinct ape. At any rate, they may be characterized as the most human-like of the apes so far known, or the most ape-like of any man yet discovered. But the real importance of the find in Java lies in the fact that we may hope for further discoveries which may throw light on man's origin. There are still vast areas of Quaternary and Tertiary deposits in Asia, Africa and the islands of the Indian Ocean which await investigation, and it is not too much to hope that the next twenty-five years will see greater advances in our knowledge of man's past history than we have seen in the last century.

There is another problem awaiting solution and it is, to a certain extent, bound up with the one just considered; it is the old question, put in a new form, of the single or multiple origin of man—monogenism or polygenism. The facts as at present known are these: With the exception of the Java find and possibly one or two skulls found in Europe, man seems to be not only *man*, but go back as far into the past as we can, we find the several types of mankind already existing as we know them to-day. On the most ancient of the Egyptian monuments we see depicted in a distinct manner the Egyptian Fellah, the Hadandowah and the Negro. If we consider the skulls which have been found in Europe and America along with bones of extinct mammals we have the long heads and the short heads—the types which appear to-day, and which furnish much of the basis of anthropological classification. Where or when did the lines begin to diverge? Was it due to a plurality in man's ancestry or was it due to environment? And why have the types of ancient times persisted down to the present day? We do not know yet why the skin of the negro is black, any more than we know why it remains black; nor do we know why his hair in cross section is long and narrow in shape, while that of the Indian is circular.

These questions and riddles are simply part and parcel of the great problem of heredity, and if the study of anthropology does no more than solve that, it will amply have earned its title to recognition. A distinguished English anthropologist declares that even to-day there may occasionally be noted the reappearance of physical types which existed in Europe contemporaneously with the cave-bear and the mammoth; while one of America's foremost anatomists has declared that in the occasional appearance of a third trochanter we have a survival of a structure which is an essential feature of the horse and the rhinoceres. When we know preciesly what heredity means, what can be inherited and what can not, then we may hope to know more of man's origin and of his destiny.

But the subjects of investigation are not only to enquire into the past; they include the men, the races of to-day. Surely the field is broad enough here, and no one who has explored even a corner of it doubts its importance and interest. But how much do we know of it? The physical history of the races of Europe has only been written within the last five years and it is far from complete. What do we know of the peoples of Africa or of the aborigines of America? Not nearly as much as we know of the mammals or of the butterflies of these countries. Yet in these peoples we have, if we would but look, a picture

full of suggestion as to man's primitive condition. It is as if the geologist could visit some remote spot and behold the earth as it existed in Tertiary times. Would he neglect the opportunity? In many of the peoples of Africa and Oceania we find types of bodily structure which are not described in the anatomical text-books of Gray or Quain. There we may see important differences from the European type in cranial capacity, in the size and structure of the brain, in the relative lengths of the arm and leg, in the pelvis, in the musculature of the hand and foot, in fact in the entire bodily structure; and these differences are significant. In the heart of Africa are dwarfs that in bodily structure and mental calibre are very far removed, indeed, from the European. In other parts of the world dwarf races have lately been discovered. Are they the survivals of primitive times, or are they the degenerate offspring of a once vigorous ancestry? These are a few of the subjects still awaiting investigation.

The field is surely broad, but how little cultivated! The proper study of mankind may be man, but curiously enough man does not seem to have cared to study mankind. As one of America's foremost students of anthropology has pointed out, man 'has never seriously and to the best of his abilities made a study of his own nature, its wants and its weakness, and how best he could amend the one and satisfy the other.' The reason for this is hard to discover, but for the present we are most concerned in the consequences; and to illustrate the extent to which a lack of the desire to study man will lead, we may take a single example. Among the general instructions to the officers of the Challenger Expedition we find the following:* "Every opportunity should be taken of obtaining photographs of native races to one scale; and of making such observations as are practicable with regard to their physical characteristics, language, habits, implements and antiquities. It would be advisable that specimens of hair of unmixed races should in all cases be obtained." And what was the result? From an expedition which in its importance ranks only after that of Columbus and Magellan; which consumed years of time and cost the British government in round figures $600,000—from this expedition the total contribution to the knowledge of the races of men were some notes by two of the officers, a few unsatisfactory photographs, a few bones of skeletons and *sixty-four* skulls! There is a serious side to such a neglect of opportunity as this.

*I am indebted for this information to *Natural Science*, Vol. VII., No. 41, Special 'Challenge' Number, pp. 7 and 74.

In 1803 Tasmania's population was 7,000; to-day there is not a single representative left. In 1842 the Maoris of New Zealand numbered 140,000; to-day there are less than 30,000. When Macaulay's New Zealander gazes on the ruins of London there will be no New Zealander; the name 'Maori' even will be as unfamiliar then as is now the name of some obscure Germanic tribe of the times of Tacitus. What is true of New Zealand is rapidly becoming true of all the islands of the Pacific; it is true of nearly all the North American continent and for large areas of the Southern.

The field for the study of physical man is broad, but the scene is ever changing, and it behooves us to-day, if we would not merit the just condemnation of the ages to come, to observe, to record, to make use of the camera, the phonograph, the calipers and the color-scale. But how often on any of the great scientific expeditions is there any one fitted by previous training to observe correctly and accurately the races of men that may be encountered? Recall, if you please, the numerous expeditions which have penetrated Africa, crossed Asia and

traversed the islands of the Pacific, and we find men competent to observe and collect reptiles and birds and fishes and mammals, to study botany and geology, but how often is anthropology represented? Surely no one doubts that previous training is just as essential in the one case as in the others. But there is already an attempt in some countries to remedy this. In London, Paris and Berlin one can receive instruction from competent teachers as to the best methods of recording and observing, as well as a knowledge of what is best to observe and record. As a result of this, a widespread interest is being manifested in anthropological matters by army and naval officers, as well as by the civilians of the European countries, and there is growing up in each of the great Continental cities storehouses of information about the peoples of the different parts of the world. Not only that, but the universities are awakening to the importance of the study of man. As a sign of the times, we may read in one of the February numbers of *Nature:* "Dr. A. C. Haddon is this term giving two well-attended classes (one elementary and one advanced) in physical anthropology at the Anatomy School." And what is true of Cambridge is true to a greater or less extent of fifteen other European universities.

In America, while general instruction in anthropology has for number of years been given in several universities, a special course in physical anthropology is offered by Dr. Boas in Columbia for the first time this year, and in the University of Chicago courses covering the entire field of physical anthropology have been given by Professor Starr since its foundation.

(c.) *Physical Anthropology in Relation to Museum Exhibition.*

Up to the present time there is no museum or section of museum which adequately or worthily represents the subject of physical anthropology. There are museums of zoology, of botany, of geology and of anatomy, but no museum which shows the races of men as they should or might be shown. Obviously, it will be beyond the limit of our time to treat, with any degree of fullness, of the possibilities of a museum of physical anthropology, but we can at least attempt to lay down the general lines on which a museum should be built, and which ought to be possible of accomplishment.

The ideal museum of physical anthropology then will have at least three sections or divisions. In the first should be shown the instruments and apparatus which are used for making and recording the various observations which are taken both on the living subject and on the cadaver or skeleton. By the use of charts and diagrams the methods of tabulating and recording these observations may be shown. There ought, furthermore, to be in this section a room or rooms in which an individual who applies can be measured or tested according to the accepted standards of anthropometry and psychometry. Such facilities would serve a twofold purpose. To the subject they tend to awaken an interest in himself and may be useful in indicating physical and psychical defects or weaknesses which may be easily remedied. From personal interest in the subject to a broader and more thorough understanding of the aims and methods of anthropology, is a matter of easier accomplishment after the individual has had even this slight introduction to the science. On the other hand, these observations on the living subject, when made in sufficient quantities, enable the observer to draw valuable deductions in regard to vital phenomena, such as the laws of growth, sexual differences, the influence of nationality, of climate, of nourishment and of occupation, together with the effect of all these on stature, on lung capacity, on strength, on mental activities, etc. Much

has been done along these lines that is valuable, but many important problems have yet to be investigated, the solution of which will help not a little to a more correct understanding of the possibilities and limitations of human life.

In the second section of this ideal museum the aim will be to interpret and explain physical man. Naturally, the subject is treated in the broadest and most general way, the object being primarily to exhibit man as a zoological unit; but there must be many sub-sections or divisions. In one group we may properly begin with the embryological history of man. Such an exhibit is not only possible, but, owing to the improved methods of museum display, can be made very attractive as well as instructive. Not only can man's interuterine life be shown by means of alcoholic specimens, but this may be thoroughly well illustrated, and even the early stages rendered visible, with the aid of the wax and plaster models, which are now made with the greatest exactness and scientific accuracy. With such assistance, many of the most interesting facts of man's history can be made clear. For example, as the various stages of embryonic life are unfolded, we see as it were an epitome of man's past history, for it is one of the laws of biology that the developmental history of the individual is a resumé of the developmental history of the race. By the illustration of this law, as man is seen to pass successfully from the stage of a single cell, through that of a jellyfish, when later he has the gill pouches of a fish, and the freely projecting tail of mammals, the fact is burned in that man is but a 'link in the chain.'

Another subsection will be devoted to the skeleton. No matter where the skeleton is to be placed or what part it is to play in the exhibit of other branches of zoology, in physical anthropology its place is *not* in the closet, but in full sight; and one museum at least in America has ably demonstrated that the skeleton can be made as beautiful, as attractive and as interesting as any subject of a natural history exhibit.* Furthermore, the skeleton may or may not be morphologically valuable;† it forms an extremely important part in any exhibit of man. Of all the bodily systems it is easiest preserved and the most enduring; it alone of the body furnishes us with our knowledge of extinct and fossil man.

The first object in the exhibit of the skeleton is to make easily familiar the names, positions and relative importance of the various members, individual bones and parts of bones; in other words, there should first be an illustrated text-book of normal human osteology. The visitor is then prepared for something better and we may next show the development of the skeleton. First to be shown would be the fœtal skeleton in ligamentous preparations, and then a series of articulated skeletons, ranging in age from birth to full maturity, terminating with the skeleton of old age. The attempt may next be made to show the range of variation of the skeleton, not for the European race, but for man, drawing for our material upon all races. This series can be made of the greatest interest, and when properly formed and labeled is of the utmost importance. We should have in this group two series, one showing the descriptive variations or those which can easily be detected by the eye and readily and fully described in the labels; the second series illustrates those variations which are best described by terms of mathematical precision. As an example of the first series we may mention, to take the skull alone, the variations in the sutures or lines of articulation of the bones, their degree of serration, the time in life of closure, the

* The Wistar Institute of Anatomy and Physiology in Philadelphia.

† Cf. Minot's Human Embryology, p. 422.

influence of the shape of the head by premature closure, anomalous sutures such as the persistent frontal or subsagittal or interparietal, and, finally, the supernumerary bones which appear occasionally in certain sutures. As examples of the second series we may illustrate such craniometrical observations as the variations in the cubic capacity of the skull, or the cephalic index—the relation of the length to the breadth of the skull; or, of other parts of the skeleton, the various forms of pelvic and scapular indices. Still another but minor group should illustrate the diverse forms of artificially deformed skulls which are found in various parts of the world, and along with them should be shown the cradle-boards, bandages and other appliances which were used to produce such deformation.

If we include the teeth in our exhibit of the skeleton there is much that can be shown. Thus we would have illustrated the time of eruption of the milk and permanent teeth, the degrees and causes of wear, the appearance of the jaws due to loss of teeth, and the changes which have taken and are taking place in man's dentition. Still another series or subsection presents in one comprehensive view the skeleton of man by the side of those of his first and second cousins, from the gorilla down to the lowest lemurs, including the models or casts of the earliest human bones which have yet been found. In fact, the limits are very wide to this section which is devoted to the skeleton. Many of the changes which have taken place in man's gradual acquisition of the upright position can be shown and made most instructive; such modifications can still be seen in the pelvis, the bones of the arms and legs, the shoulder-blade, and in the gradual shifting of the great body cavities, as seen in the variation in the number of ribs and vertebræ and the gradual shortening of the breast-bone. This, by no means, exhausts the interesting and instructive changes which can be rung on the skeleton and its component members. But all of this requires an unlimited supply of material from widely distinct races; it also requires, for purposes of illustration, free access to the skeletons of apes and other mammals, and even of lower vertebrates.

But of the first general section we have considered only one system of man's structure; the others should have their proper amount of attention. Here we meet with a real difficulty; the other systems are only prepared and exhibited at considerable labor and expense, and, worst of all, we can not have such free command of material from all races from which to draw. We can dig up the bony remains of the Papuan, but he refuses to be dissected. There is, however, much that can be shown. Take the muscular system; by means of alcoholic and dried preparations, and by following a definite scheme, we can hope to show some of the variations which demand 900 pages for their description at the hands of a French anatomist.* By a careful arrangement we can demonstrate that certain muscles are peculiar to man, those which are required by his upright position and especially by the extended use to which he puts his hands; that he retains other muscles which he no longer needs, as, for example, some of the muscles of his ears and feet; and, finally, that there are occasionally present muscles which, in general, man has lost, but which still survive in an extremely rudimentary condition in some men, such as the caudal or tail muscles.

With the *nervous system* the problem of exhibition becomes at once less difficult again, and the possibilities of museum display are very great. Those who were fortunate enough to have visited the Section

* Testut: Les anomalies musculaires chez l'homme. Paris, 1887.

of Neurology* in the Anthropological Building at the World's Fair need not be told of the pleasure which may be derived from a thoroughly well arranged exhibit of the nervous system. In the ideal museum it will be possible to read the story of the development of a man's brain, from its lowly beginning as an infolding of the outer germ layer to that complete organ of the adult which in its structural form so closely resembles the brain of the higher apes, but which in its potentialities and possibilities is as far removed as man himself is from the brute creation. But there is more than mere development to be shown. Even the brain of the adult is subject to great variation from the normal, and all these variations are interesting from the standpoint of morphology. Then there is the correlation of the brain to the skull which must be shown, along with the casts of the cavity of the skull. The subject is by no means exhausted yet, but enough has been said to point out, although imperfectly, the possibilities which this system lends to museum purposes.

Of the other four great systems of physical man I shall stop for only one, and in that shall select a single example. I refer to the variations in the arch of the aorta, the great blood vessel which leads from the heart. In all the systems or parts of systems of man's structure there is none, perhaps, which betrays his humble origin so well or so convincingly as the variations which we find here. It is not that in the embryological development of the circulatory system in general we can trace man's pedigree from a condition more primitive than that of the fishes, but that, to return to our example, in the adult variations of the aorta we may find a single aortic arch on the left side, the normal condition; or a single arch on the right side, the condition of birds; or a right and left, or double arch, the condition in reptiles.

* Under the able direction of Professor H. H. Donaldson, of the University of Chicago.

In all of these four great systems, to say nothing of man's outer covering, such as the skin and hair, there are similar interesting facts, which, by means of corrosive and injection preparations or preservative fluids, may be exhibited in an attractive manner and serve as illustrations for the text-book of humankind.

In the third section we do not consider man, but men; not the species man, but the varieties of men; and hence we may characterize this section as special or ethnic. The aim is to present, as compactly and attractively as possible, a bird's-eye view of all the groups of people from all parts of the world. Such an exhibit, properly made, carefully installed, and fully and accurately labelled, ought easily to excel in interest any exhibit that can be made of any department of science. An exhibit, for example, of a group of casts of Australians, true to life in color, expression, form and dress, is just as much more interesting than a group of stuffed kangaroos as a group of live Australians is of more interest than a group of live kangaroos; and for proof of the correctness of the latter observation one need only take a single glance at the distribution of a crowd at a circus.

As to details, of course, there will be much divergence of opinion, but we cannot go very far astray if we follow, as a general rule, a geographical order. There will be times, to be sure, when it will not be practicable or wise to do this, but if we begin with the dark-skinned races, such as the Negrittoes, Papuans, Australians, and Negroes of Africa, we can readily pass over to the brown or insular peoples of the Pacific, such as the Malays, Indonesians, etc. We can next take up the continent of America, and then, passing over into Asia by the northwest coast, can cross Asia and so finally traverse Europe. In this manner

we shall not only have circumnavigated the globe, but have done it in an orderly manner, and at the same time have kept near to the line of the physical development of the races.

Naturally, when we come to select the groups and tribes to be represented there will be more difference of opinion, but the main point is to select such groups as are *types*, those which show decided variation from their neighbors, either in color, in stature, in hair, or in physiognomy. The limit to be put on the number of the groups will, of course, be determined very largely by the means at our command for this purpose, but certainly an exhibit which includes less than sixty groups would be incomplete and more or less unworthy of the subject.

There is next to be determined the exact character or nature of the material which is to be included in each group. This again must, to a large extent, be a matter of expediency or possibility. For some groups an abundance of material will be available; for others we must be content with a scant amount. But still it will be possible to keep in mind a standard below which it will be unwise to fall. There should be on the one side the group of casts, colored and dressed with the utmost accuracy and scientific precision. From these figures can be studied the color, shape, size, hair, facial expression, relative length of limbs, shape of hands, feet, etc., as accurately as from the living subject. This should include at least three figures—the man, woman and child. By their side we may show the mounted skeletons, the scaffolding of the body. On the opposite side are series of skulls, shoulder-blades, pelves, long bones, etc., selected in such a manner as to present the typical osteological characters of the group we are representing. At the center and in the back are type photographs, anthropometric charts, diagrams of sections of hair, etc., and a map showing the exact geographical distribution of the group. Other maps or charts showing the physiography, fauna, flora and climate should be added whenever possible. Every object exhibited is to have its own individual label, and there is, of course, to be in the center a comprehensive label which sets forth in brief, concise language the chief characteristics of that particular group.

In other words, as the first section illustrates the aims, objects and methods of physical anthropology, as the second section defines and exhibits the species man and sets forth his position in the animal world, so this, the third section, is an illustrated text-book of races and peoples, of ethnography.

But we are not yet concluded with our scheme for an ideal museum, for so far provision has only been made for the casual visitor and the thoughtful student; provision must also be made for the investigator. A museum which fails to have its study series can never be considered complete. The museum can not, it does not, aim to supplant the universities, but it should aim to supplement them. It should clearly be borne in mind that the museum of to-day, if it is to be worthy the name, must be built up from the results of field exploration and investigation. No systematic or comprehensive scheme for a scientific museum can be carried out from random gifts and occasional purchases. Accessions from such sources as these may in time grow into vast *curio halls*, but never into the scientific museum worthy the building which houses it, or the time of its care-takers.

It is rare, indeed, that it is possible or desirable to place on permanent exhibition all the material which may be gathered from any single expedition. The duplicates, thus acquired, are too often regarded as encumbrances, fit only for purposes of exchange, or, if that be impossible, they are

piled away in the attic, or even, worse still, in the bottom compartments of the exhibition cases, there to grow mouldy or to be eaten up by the moths. But in the real museum such duplicate specimens, and those not suitable for exhibition purposes, are carefully assorted and those which may be of interest to the student or investigator are arranged in suitable compartments in well lighted rooms, where they may be readily available for study. Such series represent the 'stack' of a great Library; they make possible rearrangement and extension of the exhibition series, and, best of all, they give to the museum, in direct proportion to their fullness, completeness and permanency, and serve the purpose of awakening not a local, but a national interest. Such series would contribute largely to obviate the necessity of American students going abroad for material for study.

(d) *The Importance or Value of Physical Anthropology.*

And now, last of all, we have to consider this question: Is the study of anthropology worth the time, and is its proper exhibition worth the cost and labor? In other words, what is the ultimate aim of physical anthropology, what can it teach, what is its value?

The aim of physical anthropology is to *know* physical man, to unravel the mysteries of his nature. It follows the individual throughout the entire course of his life. It enquires into his origin and his evolution down to the present day. It enquires into the varieties of man and asks for the causes which have made these varieties; why are some men black, why are others white, and, more difficult to answer, it asks why the black remain black and the white remain white. Its aim is to enquire into the condition of physical progress, to study the effects on man of soil and climate; in short, of environment. It enquires into the laws of heredity and descent, into the laws of health and disease, and it asks for the factors which make for longevity and robustness, a sound mind in a sound body.

Physical anthropology teaches us that all men are not born equal; that every child at birth is "endowed with the heritage transmitted from innumerable ancestors, and is already rich in personal experiences from its prenatal life; that these combined decide the individual's race and strain, and potentially incline, if they do not absolutely coerce, his tastes and ambitions, his fears and hopes, his failure or success."* It teaches us that man has acquired, and only recently, his upright position, and that he is not yet perfectly adapted to it; that the evolution of sex has gone on further in man than in other mammals; that the entire structure is slowly and progressively modified from birth to adult age; that then retrogressive changes set in which, in some respects, are infantile in character. It teaches not only that there has been a gradual evolution of man's physical nature, but that influences are still at work which will produce yet further changes and modifications; that the man of the future will not be like the man of to-day.

The aim of physical anthropology is to know physical man, and herein lies its value; for when we know man then can we answer some of the problems which confront man, and on the proper solution of these problems rests the destiny of nations and the ultimate destiny of man himself. These problems are many, and demand immediate answer. Morphology, the study of variation, is the hand-maid of pathology, and a knowledge of the causes of disease will aid materially in its prevention. With a larger and more enlightened view of the effects of environment, we can hope to see

* Brinton: The Aims of Anthropology, SCIENCE, Vol. 11., 1895, p. 241; Proc. A. A. A. S., Vol. 44, p. 2.

solved the problem of acclimatization, a problem which so far has baffled physicians, and which has even been declared insoluble; but which, if ever solved, will change the complexion of the earth's surface and inaugurate a new era in the history of mankind. A broader knowledge of physical man will throw light on that most intricate and obscure problem of miscegenation or race-intermarriage, a problem which, it has been declared, is exceeded by no other in its effects on the 'future prosperity or failure of the human species.'

The study of physical anthropology teaches us that not only are all men not born equal, but that tribes and races and nations are inevitably doomed to give way and perish before the advance of their more fortunate fellow-men; that the time is not far distant when a certain few races will have peopled the globe, when no survivor of the native population will exist on a territory which covers an area of twenty-five million square miles and which, four hundred years ago, contained one hundred million inhabitants.

To know physical man, his past history, his present possibilities, his future destiny—such is the aim and value of physical anthropology, but not least in value is to teach him his place in nature.

GEORGE A. DORSEY.
FIELD COLUMBIAN MUSEUM.

THE ASSOCIATION OF AMERICAN ANATOMISTS.

THE ninth annual session of the Association was held in the Columbian University Scientific School, Washington, D. C., Tuesday to Thursday, May 4 to 6, 1897, in conjunction with the other societies comprising the Congress of American Physicians and Surgeons.

Dr. Frank Baker, President of the Association, presided at the several meetings. The following members were present at some time during the session: Baker, Bevan, Blake, Bosher, Browning, Carr, Dawbarn, Gerrish, Gill, Hamann, Hewson, Hodge, Hunt, Huntington, Hutchinson, Kemp, Lamb, Leidy, Mears, Miller, Mixter, Moran, Parkhill, Reisinger, Roberts, Shepherd, West and Wilder—28 in all.

The Association was called to order by the President who delivered an address, which will be printed in SCIENCE.

Dr. D. S. Lamb, Secretary and Treasurer, submitted his report for the period which had elapsed since the last session, December 27 and 28, 1895, which was accepted. The following are extracts: "No meeting was held in December, 1896, in view of the fact that this Association is a member of the Congress of American Physicians and Surgeons, which meets in this city in May every third year. The Executive Committee believes that if we should meet both in December and the following May the short interval between the meetings would imperil the success of the May meeting, at the same time regretting that by postponing the December meeting we lose the opportunity of attend- the sessions of the Society of American Naturalists and the affiliated societies. This is the second time this postponement has occurred and in the nature of things seems inevitable every third year.

"Since the last meeting three members have died. Sir George Murray Humphry, an honorary member, professor of surgery and late professor of anatomy in the University of Cambridge, England, died September 24, 1896. He is perhaps best known as the author of a classic work on 'The Skeleton.' Dr. Charles Heitzmann, of New York City, at one time lecturer on morbid anatomy in the University of Vienna, and who afterwards conducted a Histologic and Pathologic Laboratory in New York City, author of a work on anatomy, having occasion to go to Europe for his health, resigned September

16, 1896. Sometime afterwards I saw a notice of his death while abroad ; the exact date I cannot give. Professor Edward Drinker Cope, professor of vertebrate paleontology in the University of Pennsylvania, and author of many works on American Paleontology, died in Philadelphia, April 12, 1897."

The Executive Committee reported favorably on the following applications for membership: Drs. V. P. Blair, J. A. Blake, Thomas Flavin, C. M. Miller, J. T. Moore, and E. W. Reisinger and Mr. C. T. Ward; all of whom were elected.

Dr. Lamb, from the Committee on Anatomical Peculiarities of the Negro, reported a 'List of Items' and 'Letter of Instructions' to accompany the same. Dr. Wilder suggested several changes in the terminology, which were accepted by Dr. Lamb for the Committee. On motion of Dr. Huntington, the Association ordered that copies of the report should be printed and distributed among the members for their information and criticism along with the statement that the *terminology* should not be considered as necessarily being that which the Association might ultimately recommend.

On motion of Dr. Huntington, the annual dues were increased to three dollars; the increase to begin with the year 1897–98.

Dr. Huntington, of the Medical Department of Columbia University, New York City, then made remarks on 'Corrosion Anatomy, Technique and Mass ;' illustrated by the material and specimens. The subject was discussed by Drs. Wilder and Dawbarn.

Dr. Lamb showed the following specimens and made remarks on the same: Specimen of fissured sternum ; two specimens of sterna of young children; an extra carpal bone; bilateral bony ankylosis of jaw; and a penis, showing exaggerated papillæ on corona. Discussed by Drs. Wilder, Dawbarn, Gill, Baker and Huntington.

A paper by Dr. B. B. Stroud, of Cornell University, on 'Comparative Anatomy of the Cerebellum' was, in Dr. Stroud's absence, read by Dr. Wilder. It was illustrated by photographs and charts. Discussed by Drs. Gill, Baker, Huntington and Wilder.

At the meeting on May 5th Dr. Gerrish was elected as a member of the Executive Committee, to fill the vacancy made by the retirement under the constitution of Dr. Gill.

The Secretary stated that after the adjournment the previous day there was a consultation of several members and it was thought appropriate to send to Dr. Allen, who had just undergone an operation for appendicitis, a telegram conveying the sympathy and good wishes of the Association. The Secretary had sent the telegram. On motion of Dr. Wilder this action was approved.

Dr. Wilder then made remarks on 'The Definitive Encephalic Segments and their Designation.' Illustrated by photographs and charts. Discussed by Drs. Gill, Gerrish, Carr, Baker and Huntington. In connection with this subject Dr. J. A. Blake showed photographs of a brain with double precommissure.

Dr. Woods Hutchinson, of Buffalo, read a paper on 'A Possible Morphologic Basis for Diseases of the Lungs.' Discussed by Drs. Huntington and Baker.

The paper of Dr. Stroud on 'Brain Preservation' was read by title.

Dr. Huntington made remarks on 'Ventral Version of Secondary Fore-brain.' Illustrated by photographs. Discussed by Dr. Wilder.

Dr. William Browning, of Brooklyn, read a paper on 'Examination of Spinal Efferents for the Cerebro-spinal Fluid. Discussed by Drs. Wilder and Baker.

Adjourned.

At 5 p. m. the statue of Prof. Dr. Samuel D. Gross in the Smithsonian Park and

near the Army Medical Museum was unveiled with appropriate ceremonies, and at 8:15 p. m. the President of the Congress, Prof. Dr. Wm. H. Welch, of Johns Hopkins University, Baltimore, delivered the Presidential address, which has been published in SCIENCE.

On May 6th the Executive Committee, through the Secretary, reported a recommendation that the next meeting of the Association should be held at Cornell University in December, 1897, in conjunction with the Society of American Naturalists and other affiliated societies. On motion the Association adopted the report.

The President called attention to the fact, that inasmuch as the Congress met every three years, the election for delegate to its Executive Committee every two years seemed to cause some confusion. After some discussion Dr. Hewson moved that hereafter the election for delegate occur every *three* years, and this was adopted. Dr. Wilder, from the Committee on Anatomical Nomenclature, reported progress. Report accepted. Dr. Gerrish, from the Committee auditing the Treasurer's account, reported the accounts correct.

Dr. Huntington made remarks on 'The Cerebral Convolutions of two Brains from Natives of British Guiana.' Illustrated by casts and photographs. Discussed by Drs. Baker and Wilder.

Dr. F. J. Shepherd, of Montreal, showed a specimen of double internal cuneiform bone of right foot of a white woman aged 17; and photographs of hands and feet of same subject, showing multiple digits.

Dr. W. P. Carr, of Washington, showed some anatomical models on a large scale illustrating the circulation of the blood through the heart, the formation of a blood-vessel, and the corona radiata. Discussed by Drs. Wilder, Huntington and Shepherd.

Dr. Blake read a 'Contribution to the Topographical Anatomy of the Mediastinum Superior Theoracic Aperture.' Discussed by Drs. Baker, Wilder and Huntington.

Dr. Addinell Hewson, of Philadelphia, showed the forms of record used in the dissecting rooms of Jefferson College, Philadelphia, Pa., and made remarks thereon. Discussed by Drs. Baker, Huntington, Reisinger and Wilder.

Dr. C. A. Hamann, of Cleveland, showed specimens of congenital malformation of the extremities. Discussed by Drs. Huntington and Geo. T. Kemp.

The Association then adjourned *sine die*.

After the adjournment, at the suggestion of Dr. Kemp, Dr. G. C. Huber, of the University of Michigan, exhibited slides showing the terminal endings of the nerves in the epithelium of the urinary bladder and the sensory nerve endings of the muscle.

D. S. LAMB,
Secretary.

*SYSTEMATIC CLASSIFICATION OF TEXTILE AND OTHER USEFUL FIBERS OF THE WORLD.**

THE advantages of a broader and more systematic classification for textile and other useful fibers has long been appreciated by the author. While engaged in the preparation of a descriptive catalogue of fibers of the world in which over a thousand species of useful fiber plants are enumerated, the necessity for a better classification became apparent, and the scheme herewith presented was devised. The term fiber is popularly understood to relate to those forms of filamentous substance that can be spun and woven, or twisted into cordage, though it should not be employed in so restricted a sense. In fact, many of the true fibers are used in other ways, for there are kinds of cordage, and even cloth substi-

*Abstract of a paper read before the Philosophical Society of Washington, by Chas. Richards Dodge.

tutes, that are neither spun or woven. On the other hand, there are many forms of fibrous substances of the roughest description, such as reeds or shredded palm leaves, that are plaited, this being a coarse form of weaving, so that it becomes difficult to draw the line between a fine spinning fiber like flax, that is woven into linen fabrics, and a sedge, coarsely woven into matting, or a woody twig of Salix plaited into a basket.

In the classification proposed two groups are recognized, based on cell structure. The first, fibers with fibro-vascular structure, embraces three sub-groups, and the second, fibers with simple cellular structure, embraces two sub-groups. The classification is as follows:

A. FIBRO-VASCULAR STRUCTURE.

1. Bast Fibers:

Derived from the inner fibrous bark of dicotyledonous plants or exogens, or outside growers. They are composed of bast cells, the ends of which overlap each other so as to form, in mass, a filament. They occupy the phlöem portion of the fibro-vascular bundles, and their utility in nature is to give strength and flexibility to the tissue.

2. Woody Fibers:

a. The stems and twigs of exogenous plants, simply stripped of their bark and used entire, or separated into withes, for weaving or plaiting into basketry.

b. The entire, or subdivided *roots* of exogenous plants, to be employed for the same purpose, or as tye material, or as very coarse thread for stitching or binding.

c. The *wood* of exogenous trees easily divisible into layers or splints for the same purposes, or more finely subdivided into thread-like shavings for packing material.

d. The *wood* of certain soft species of exogenous trees after grinding, and converting by chemical means into wood pulp, which is simple cellulose; and similar woods more carefully prepared for the manufacture of artificial silk.

3. Structural Fibers:

a. Derived from the structural system of the stalks, leaf stems and leaves, or other parts of monocotyledonous plants or inside growers, occurring as isolated fibro-vascular bundles, and surrounded by a pithy, spongy, corky, or often a soft, succulent, cellular mass covered with a thick epidermis. They give to the plant rigidity and toughness, thus enabling it to resist injury from the elements; and they also serve as water vessels.

b. The whole stems, or roots, or leaves, or split and shredded leaves of monocotyledonous plants.

c. The fibrous portion of the leaves or fruits of certain exogenous plants when deprived of their epidermis and soft cellular tissue.

B. SIMPLE CELLULAR STRUCTURE.

4. Surface Fibers:

a. The down, or hairs surrounding the seeds, or seed envelopes, of exogenous plants, which are usually contained in a husk, pod or capsule.

b. Hair-like growths, or tomentum, found on the surfaces of the stems and leaves, or on the leaf buds of both divisions of plants.

c. Fibrous material produced in the form of epidermal strips from the leaves of certain endogenous species, as the palms.

5. Pseudo-Fibers, or False Fibrous Material:

a. Certain of the mosses, as the species of *Sphagnum*, for packing material.

b. Certain leaves, the dried substance of which forms a more delicate packing material.

c. Sea weeds wrought into lines or cordage.

d. Fungus growths, or the mycelium

of certain funguses that may be applied to economic uses for which some of the true fibers are employed.

In the portion of the paper which followed, the different forms of fibers were defined in detail and examples given from the list of well-known commercial and native or aboriginal species. It is the consideration of these useful native fibers that makes it possible to enumerate a list of a thousand species of fibrous plants, while the world's commercial fibers would hardly reach a total of fifty species. The native or aboriginal forms are interesting; our museums are filled with manufactures from them, and any scheme of systematic classification which omits them is faulty and imperfect.

CURRENT NOTES ON ANTHROPOLOGY.

PIGMENTATION OF THE SKIN.

M. Breul, in an inaugural thesis reviewed in *L'Anthropologie*, reports some new observations on the pigmentation of the human skin.

The colors of the different races depend upon this pigment in the epidermis, especially in its deeper strata. Breul finds the coloring matter in the interior of the epithelial cells, while even in the negro the intercellular spaces are white. The pigment itself may be quite black, or of any shade up to a light yellow. It may be confined to the nucleolus, or extend over the cell. A close examination shows that it is distributed in patches over the skin, between them the tissue being colorless. This is true even of the black races, although in them the patches are close together and may not be discernible unless the skin be stretched.

This distribution of the coloring matter is the same in all races. and its actual amount is probably the same, the difference in hue resulting from the darker or lighter character of the pigmentary grains.

HOLMES' RESEARCHES IN MEXICO.

The second part of the 'Archæological Studies' of Professor William H. Holmes (for a notice of the first part, see Science, February 21, 1896) is devoted to the 'Monuments of Chiapas, Oaxaca and the the Valley of Mexico.' It is a most attractive monograph, based on original personal studies, and containing nearly forty full-page plates, panoramic views and numerous text illustrations. The ruins described are those of Palenque, Monte Alban (in Oaxaca), Mitla and San Juan Teotihuacan. The volume closes with a series of 'Studies of Ancient Mexican Sculpture,' referring to tablets, yokes, figures and carved shells.

The text is full of new suggestions and comparisons, as well as of facts. The architectural elements of the various sites are analyzed and compared, and the sources from which the materials were obtained were carefully sought out. Nowhere was any evidence found of the use of metals, or a condition of the arts above that known to have existed at the discovery, although the stately monuments of Oaxaca and Teotihuacan testify to an astonishing concentration of effort for prolonged periods. The remains in Mexico are more magnificent in dimensions, but on the whole less artistic than those of Yucatan or Chiapas.

D. G. Brinton.
University of Pennsylvania.

NOTES ON INORGANIC CHEMISTRY.

In the last *Comptes Rendus* a new atomic weight determination of cerium is described by Wyrouboff and Verneuil. The element was obtained in a state of great purity, and the determinations made by converting the sulfate into the oxid by heat. The atomic weight is given at 92.7, but this is on the supposition that the oxid obtained is Ce_3O_4. It is ordinarily considered that the formula of this oxid is CeO_2, which would

give an atomic weight of 139.05, or about one unit lower than the best previous determination. According to this last weight, cerium is a member of the first series of Mendeleff's fourth group, and to this the oxid CeO_2 corresponds. It is true that many of the properties of cerium do not agree well with this position, but the atomic weight of 92.7 can hardly be brought into harmony with the periodic system, as there is no vacant place between zirconium (90.4) in the fourth group and columbium (93.7) in the fifth group.

E. CHUARD, in the *Comptes Rendus*, suggests the use of calcium carbid as a phylloxericide. The presence of phosphorus in the carbid is advantageous, as the phosphocarbid possesses exceptionally powerful insecticidal properties, probably owing to the generation of acetylene rich in phosphin, or possibly containing a phosphorus-carbon compound.

A RECENT number of *Nature* contains a notice, taken from the Journal of the Russian Physical and Chemical Society, of the death of Dr. Véra Bogdanovskaya-Popoff, who was killed on May 8th in her laboratory at Izhora by an explosion. She had been working to obtain a compound of carbon and phosphorus, analogous to prussic acid, but with phosphorus in the place of nitrogen, and it was while engaged in this dangerous investigation that the fatal explosion occurred.

IN a paper read before the Royal Society on June 17th, W. J. Russell describes the action excited by certain metals and other substances on a photographic plate. Experiments showed that uranium salts and oxids act slowly on photographic plates in the dark; this property is shared by metallic zinc, cadmium and magnesium, as well as many other substances, as copal, strawboard, wood, some kinds of paper. This action was at first supposed to be contact action, and then it was thought that in the case of metals minute emanations might be given off. This, however, is negatived by the fact that zinc acts equally well when not in contact with the plate, and even when completely insulated by a coating of varnish.

THE June Journal of the Chemical Society contains a paper by Dr. John Ball on the circumstances which affect the rate of solution of zinc in dilute acids, with especial reference to the influence of dissolved metallic salts. It is a familiar fact that the action of pure zinc on sulfuric acid is very slow, but may be greatly accelerated by the addition of certain metallic salts. Platinic chloride is generally used for this purpose, and less frequently a cobalt salt. Dr. Ball finds that with sulfuric acid, magnesium or aluminum sulfate have no accelerating influence, that of chromium, manganese and iron is very slight, silver is greater, while cobalt, copper and nickel sulfates have great influence and in this order. The relative maximum velocity of solution, taking the velocity of pure sulfuric acid as unity, is for the addition of silver sulfate, 9; cobalt sulfate, 18; copper sulfate, 21, and nickel sulfate, 38. In the case of solution in hydrochloric acid the addition of manganese, lead or tin chloride had but little influence, copper somewhat greater (11), while the relative velocities for cobalt, gold, platinum and nickel were respectively 31, 39, 42 and 45. It will be seen that with both acids the addition of a nickel salt causes the greatest acceleration, and the relative order of the different methods is approximately the same, except that copper has much less influence on the solution in hydrochloric acid. Dr. Ball presents no theory of the reaction, but it is a fact worthy of note that in the case of the two metals having most decided influence, nickel and cobalt, it could not be detected that any metal was deposited on the zinc, thus forming a couple.

J. L. H.

PHYSICAL NOTES.

THE 'DARK LIGHT' OF M. LE BON.

During the past two years M. Gustav Le Bon has brought out a remarkable fact regarding the passage of light through metals and other so-called opaque substances. This fact, so far as it can be estimated from a study of Le Bon's and others' published results, without resort to confirmatory experimentation, is either that the extreme red or infra-red components of sunlight and of gas light pass through thick metal plates sufficiently to affect sensitive plates after prolonged exposure; or that the medium wave-length components of sunlight and of gas light excite hyperphosphorescence in such metals as copper and lead just as they are known to do in case of uranium as shown by Becquerel. It seems that Le Bon in his experiments has eliminated the effects of direct pressure upon the sensitive film, the effects of temperature and such effects as might be due to chemical action between the film and the metal screens.

In the exposition of his results Le Bon is unsatisfyingly fragmentary and vexatiously notional, and it is amusing, at best, to read his claim of a new connecting region between light and electricity—*la lumière noire.* "Elle ne se propageait peut-être plus comme la lumière et peut-être propageait-elle comme l'électricité." So far as known, 'electricity,' when it is propagated at all, is propagated in a manner identically the same as light, and a fancied difference is of no use in setting forth results. Facts are plain, new facts utterly so, and a discoverer who would have it appear otherwise is either not a discoverer or does not know himself to be one. W. S. F.

SCIENTIFIC NOTES AND NEWS.

The Weights and Measures (Metric System) Bill passed through the Standing Committee on Trade of the British House of Commons on July 5th, and was ordered to be reported without amendments.

A bronze monument of Père Marquette, the priest and explorer, was unveiled in Marquette, Mich., on July 15th.

A monument in honor of Daguerre, erected by public subscription, was unveiled at Bry-sur-Marne on June 27th.

The Paris Academy has elected Professor Virchow as a foreign associate in the room of the late M. Tchebitchef. The other nominees were Lord Rayleigh, as second choice, and, as third choice, Professors Schiaparelli, Stokes and Suess.

The Right Honorable Leonard H. Courtney, M. P., has been elected President of the Royal Statistical Society.

The Royal Society of Edinburgh has awarded the Gunning Victoria Jubilee Prize to Mr. John Aitken, the Keith Prize to Dr. Kargill G. Knott, the MacDougall-Brisbane Prize to Professor J. G. M'Kendrick and the Neill prize to Mr. Robert Irvine.

It is stated in the Washington *Star* that M. Zolla has been sent to America by the French government to study methods of agriculture.

The subject of the essays for the Howard Medal and Prize of the Royal Statistical Society for 1898 is 'The treatment of habitual offenders, with special reference to their increase or decrease in various countries.'

A meeting was held on July 2d, at University College, London, to inaugurate the memorial to the late Sir John Pender, to which we have already referred. Remarks were made by the chairman, the Marquis of Tweeddale, by Mr. Haldane and by Lord Kelvin. A check for £5,000 was presented by the chairman to the authorities of University College to endow the electrical laboratory, and the bust of Sir John Pender was exhibited. Lord Kelvin spoke of what Sir John Pender had accomplished. When the first experiment was made to lay a cable across the Atlantic, Sir John Pender was one of the directors of the company. When the temporary success was followed so soon by

failure, the directors resigned one after the other, and it was due to Sir John Pender alone that the undertaking was not abandoned in the period from 1858 to 1864.

WE regret to record the deaths of Samuel Brassai, professor of mathematics at Klausenberg, at the age of one hundred years; and of Dr. H. Wankel, of Olmütz, known for his researches in anthropology and archæology.

THE Librarian of Congress has made several excellent appointments, but has offered the position of chief of the art department of the Congressional Library to a newspaper correspondent. It is, perhaps, thought that connection with the New York *World* gives an adequate training in modern art.

THE government of La Plata has made arrangements for securing the services of a bacteriologist whose duty it shall be to make an experimental study of tropical epidemics.

MESSRS. KADY, Berg and See, architects, have submitted to the Department of Buildings, New York, plans for two additions to the American Museum of Natural History, one a lecture hall at the north end of the Museum to cost $150,000, the other a six-story building attached to the west wing to cost $400,000.

THE Boissier Herbarium at Chambésy, near Geneva, which recently acquired the books on lichens and the dried specimens of the late Dr. J. Müller, is, according to *Natural Science*, following the example of the trustees of the Tuckerman Memorial Library of Lichenology, Amherst, Mass., and has established a 'Lichenotheca Universalis Müller-Argau.' The curator, M. Eugene Autran, appeals to botanists for copies of publications bearing on lichens and also for specimens of new and rare species.

THE Prince of Wales Hospital fund had, up to the beginning of the present month, received donations amounting to about £130,000 and promises of annual subscriptions amounting to about £2,500. The hospital Sunday fund is, however, this year smaller than usual. It is stated that Americans resident in England have endowed with £1,000 each beds in five London hospitals, to be used in the first instance by Americans.

SIR ANDREW NOBLE has given £100 to the Royal Institute, London, for the fund for the promotion of experimental research at low temperatures.

THE State Department has transmitted to Congress a copy of the note from the Minister of Norway and Sweden, inviting the United States government to participate in the International Fisheries Exposition to be held at Bergen, Norway, May 16th to September 30, 1898, with a recommendation that an appropriation be made for this purpose.

THE seventh annual meeting of the Paris Society of Hypnotism and Psychology was announced for July 19th, under the presidency of M. Dumontpallier.

THE eighteenth annual meeting of the German Anthropological Society will be held from the 3d to the 5th of August at Lübeck. Excursions are arranged to Schwerin and to Kiel on the days following the meeting.

THE Board of Directors of the American Chemical Society have authorized the establishment of a local section at Columbus, O., the necessary steps having been taken as required by the constitution of the Society.

IT can scarcely be hoped that the letter addressed by the Secretary of State to the Ambassador at London, and for some inexplicable reason published in the daily papers, will conduce to a scientific solution of the question of the results of pelagic sealing in the Bering Sea. It is unfortunate when scientific testimony is used for conflicting political interests. It would apparently have been best for the British and American scientific experts to have drawn up a joint report containing only the facts on which they were agreed.

THE daily papers contain accounts of the arrival of a steamship from the Yukon district of Alaska, reporting great success in the Klondyke gold fields. It is reported that single individuals have taken out in two and a-half months more than $150,000 in gold.

THE steamer Svensksund has reached Norway from Spitzbergen with the news that Herr Andrée and his companions began their voyage on July 11th, at 2 : 30 p. m. The balloon was carried in a northeasterly direction.

A conference was held in the rooms of the Royal Geographical Survey, on July 5th, for the purpose of promoting Antarctic exploration. The chief object of the meeting was to bring the matter to the attention of the Australasian Premiers, then in London, with a view to inducing them to secure from their governments contributions toward a British Antarctic Expedition, under the auspices of the Royal Geographical Society. Sir Clements Markham, President of the Society, the Duke of Argyle, Sir Joseph Hooker and Professor Rücker made addresses urging the great scientific importance of exploring the South Polar regions. The Australasian Premiers were, it appears, unable to be present, but replies were made by representatives of New South Wales, Victoria and New Zealand, favoring the plan. The President said that he had been authorized to state that the Council of the Society would contribute any sum up to £5,000 which the colonial governments might subscribe.

The London *Times* states that Sir Martin Conway and Mr. E. J. Garwood left London on June 29th for Spitzbergen, in order to continue the exploration of the interior of the main island begun by them last year. They are to be landed at King's Bay, whence they hope to make sledge expeditions over the northern ice sheet. Afterwards they intend to revisit Horn Sound and complete the scientific exploration of the southern peninsula.

The London correspondent of the New York *Evening Post* cables that Mr. George Murray, keeper of botany in the British Museum, has proceeded to Panama at the instance of the government grant committee of the Royal Society for researches on little known pelagic algæ. During the voyage these organisms will be obtained by pumping sea water through fine silk tow nets.

Mr. Geo. H. Eldridge, of the Geological Survey, has completed the field investigation of the phosphate deposits of Florida, and returned to the Washington office to prepare his report. This investigation was one of considerable magnitude, Mr. Eldridge having spent one year and nine months in actual field work.

The Peary party includes, through arrangements made by Professor C. D. Walcott, Mr. Chas. Schuchert, from the U. S. National Museum, and Mr. C. David White, from the U. S. Geological Survey. They will disembark at Disco Island, off the western coast near the 70th parallel, and this island and the mainland immediately adjacent will be their field of work. Mr. Schuchert, who is in charge of the Department of Invertebrate Paleontology in the National Museum, will go in quest of Mesozoic and Tertiary fossils, and Mr. White, who is one of the paleobotanists of the Geological Survey, expects to make a large collection of the Mesozoic and Tertiary plant remains of the region visited. America has thus far secured but meager collections of polar fossils, Europe being far ahead in this regard. Mr. Robert Stein, of the Geological Survey, also accompanies the expedition, but not as an official representative of the bureau. He will leave the party at Wilcox Head, from which point he expects to make a survey of the coast north of Devil's Thumb, toward Melville Bay.

M. Marey has contributed to the Paris Academy an account, by MM. V. Tatin and Ch. Richet, of trials of an aëroplane invented by them. Their first experiments were made in 1890, but the machine was wrecked. A new machine was then constructed, with which the first trial was made last year with some success. In a second trial in June last the aëroplane travelled through the air 170 m. at the rate of 18 m. per second. The machine weighed 33 kg. The authors compare their results with those obtained by Professor Langley, and, while admitting the greater distance traveled by the aerodrome, claim that their machine had the advantage of greater weight and greater speed.

At the Royal Naval Review the performances of the *Turbinia*, a boat in which the Hon. C. P. Parsons has made use of the steam turbine for marine propulsion, excited much attention. It steamed at a speed of 34 knots an hour, and it is said that even yet the full power has never been applied.

At the recent International Congress of Publishers at Paris the inexactness of designating the size of books as 4°, 8° and 12° was dis-

cussed, and a resolution was passed to the effect that catalogues of publishers should give the actual sizes of volumes in the metric system.

THE second interim report of the departmental committee appointed by the British Home Office to inquire into and report on certain dangerous trades has just been issued as a Parliamentary paper. This report, which is signed by all the members of the committee, including the additional member, Mr. C. V. Boys, F.R.S., deals with electrical generating works. According to the London *Times* the committee has framed several regulations which they recommend should be applied in all cases where electricity at high pressure—a direct current of 700 volts or more, or an alternating current of 350 volts—is in use. The recommendations include the following regulations: The frames and bed-plates of all generating machines shall be efficiently connected to earth. The rails fencing dynamos or other generating machines shall be made of wood or other non-conducting material. The floors of all places where it would be possible to make connection with metal at high pressure should be covered with an insulating mat of suitable material and kept in a state of efficient insulation. In switchrooms and on the front of switchboards the main switches, main fuses, main terminals, omnibus bars and all other metallic parts shall be insulated or arranged in such a manner as to render it impossible for any person by accident or inadvertence to touch them. All switchboards erected after the application of these rules shall have at the back a clear space of at least four feet. This space shall not be utilized as a store room or lumber room, or be obstructed in any manner. Any person at work upon a cable or portion of the mains under high pressure shall wear india-rubber gloves on both hands, and the gloves shall be supplied by the occupier, and it shall be the duty of the manager to see that they are in a proper state of repair and are worn by the work people.

THE twenty-second annual report from the Savilian professor of astronomy at Oxford, Mr. H. H. Turner, is published in the *University Gazette* for June 23d. It is stated that the measurement and reduction of the plates for the Astrographic Chart has been the staple work of the year. The Royal Society having granted £150 from the government grant fund during the year, four or five boys who have just left school have been engaged to carry out the measures and reductions under the supervision of the assistants, and the experiment has been successful, one-tenth of the whole work having been accomplished in the last six months. The need of a residence at the observatory pressed on the attention of the board at their last meeting, and fully recognized by them, has not been acknowledged by the Hebdomadal Council. In journeying across America to and from Japan, in order to observe the total solar eclipse of August 9th, the Astronomer Royal, Captain Hills, R. E., and Professor Turner took the opportunity of visiting several Canadian and American observatories. Professor Turner acknowledges the courtesy shown to him, especially at Montreal, Chicago, Cambridge and Washington. "It would be ungrateful not to add that what we saw was of immense value to us, in the way of suggestion; the ideas acquired at the Harvard observatory alone were worth the journey, and cannot fail to leave their impress on the work here."

THE report of Dr. Gill for the year 1896, to the Lords Commissioners of the Admiralty, is abstracted in a recent issue of *Nature*. The McLean telescope is expected to be completely installed and in full working order before the end of the present year. During the last few years Dr. Gill has somewhat necessarily restricted the amount of observational work in order to make more progress in the computation and publication of many arrears, and it is satisfactory, then, to hear that it has now become possible to again resume a program of activity. Several important publications have been concluded in the last twelve months. Among them may be mentioned Vol. II., containing a determination of the solar parallax and mass of the moon, from observations of Iris, Victoria and Sappho, made in the years 1888 and 1889. Vol. I. is also practically complete. The first volume of the Cape Photographic *Durchmusterung* is also ready for distribution, Vol. II. being in course of printing. The observational work with the transit circle, equatorials and astro-

photographic telescope has been very considerable, and it may be mentioned that all the catalogue plates, with the last-mentioned instrument, have now been obtained. Out of the 230 chart plates, 169 have been satisfactorily exposed. The 7-inch equatorial has also been very busy in the hands of Mr. Innes, and, besides several new variables, 104 new double stars have been discovered. Dr. Gill refers also to the increase in staff and the necessity for a reversible transit circle for refined fundamental work, and mentions that these proposals have been favorably considered by the Lords Commissioners of the Admiralty and of Her Majesty's Treasury.

A CONVERSAZIONE was given by the President and Council of University College, London, on June 30th. According to the account in the London *Times* there were a large number of interesting exhibits. Professor Percy Gardner showed a series of archæological photographs, and Mr. Seton-Karr the interesting collection of flint implements recently discovered by him in Somaliland and Egypt. In the mechanical engineering laboratory all the machinery was in motion, besides a number of machine tools lent by various firms. In the electrical laboratory Professsor Elisha Gray's writing telegraph, by which writing may be transmitted long distances, was shown in operation by the Telautograph Company. Messrs. Harvey and Peek gave an exhibition of Tesla experiments with high-frequency currents, and Mr. J. W. Swan sent some of his experiments on electrical discharges against insulators in which curious frond-like figures were produced by the electric spark, and also a delicately-poised Gramme ring which rotated under the influence of the earth's magnetism. In the applied mathematics department apparatus and diagrams were on view illustrative of the work done and the methods of study pursued. These included various calculating machines, instruments for finding areas, and models illustrating games of chance and statistical variation and correlation. There was also a fine collection of books (mainly from the Graves Library of University College) and of portraits illustrating the history of pure and applied mathematics. In the physical lecture room experiments were shown with Hertzian waves and with the magnetic deflection of cathode rays, while Professor Ramsay exhibited the spectra of argon and helium. Some beautiful collections of begonias, orchids, roses and other flowers were to be seen in the anatomical museum, together with a collection of dwarf Japanese trees, some of them being a century old and yet only a foot or so high. Not the least attraction of the evening was Professor Flinders Petrie's exhibition of Egyptian antiquities, which includes the results of recent excavations at Deshasheh, Behnesa and El Kab.

IN one of the Harben lectures given on June 30th, at Kings College, London, Dr. Sims Woodhead discussed the antitoxin treatment of diphtheria. The London *Times* states that he showed examples of the degeneration of tissue produced in various organs of the body, even so soon as the third or fourth day of the disease, and pointed out that after these changes had occurred the physician could not expect to bring the patient back to health at once. This consideration explained the diminished curative power of the antitoxic serum in the latter stages of the disease. The life of a patient depended on the tissues being able to carry on their work, and they could do this if the action of the toxin on their cells could be prevented. In the presence of both toxin and antitoxin these dreaded organic changes did not occur. Hence, if a patient was to recover, antitoxin must be present, whether it was formed within the body or injected from the outside. The serum had both a preventive and curative action, and he would not hesitate to recommend its use as a prophylactic for people exposed to infection. As regards its remedial use the question of time was most important. The necessity of an early exhibition of the serum was illustrated by some statistics. In 1894, before the antitoxin treatment was adopted, the mortality of cases of which the treatment was begun on the first day of the disease was 22.5 per cent.; in 1896 it fell to 4.7 per cent. Of cases of which the treatment was begun on the second day the percentage of mortality decreased from 27 in 1894 to 12.8 in 1896, while in those which came under treatment in the third day the mortality was 29.4 in 1894 and 17.7 in 1896. Even in cases which were neglected till

the fifth day the antitoxin treatment effected a reduction of 6.2 per cent. in the mortality. In view of these figures, and of others dealing with the death-rate in post-scarlatinal and laryngeal cases, Dr. Woodhead expressed his strong conviction that those who opposed the use of the remedy assumed a tremendous responsibility.

MR. ALEXANDER WATT contributes to the last number of the *Bulletin de l'Institut International de Bibliographie* (why should a journal devoted to bibliography omit the date of issue?) an account of a new form of card catalogue. The usual plan of arranging a card catalogue is to place the cards in a drawer or box, a rod being run through the holes in the cards to keep them in their proper order. The examination of the catalogue is made by turning over the cards as one would turn the leaves of a book if it were laid upon its back with its fore-edge in front of the examiner. There are several inconveniences arising from this method of keeping cards. (1) A special cabinet of drawers or boxes is required. (2) As the drawers are bulky and expensive they are generally made too large (to reduce the bulk and expense), which prevents the catalogue being consulted by more than one or two persons at once. (3) It is difficult to keep a particular card in view during the copying of a title, and only one card can be readily seen at a time. In order to obviate these disadvantages Mr. Watt has devised a new receptacle for holding the cards, consisting of a case made in the form and of the materials of the boards of a book. The cards are placed between the boards of the case and are held in position by means of a pin passing through the *outer* corner of the cards and case. The pin, which is made to exactly fit the hole in the cards, has a fixed hole at one end and at the other end a head which screws into the pin. The cards during examination, instead of sliding along the pin, are rotated on it outwards *en bloc*, and may be spread out in the form of a fan so as to keep in view several cards at the same time. As the cards are examined they are pushed back into the case, one or more at a time. As the cases (which may be made of any thickness) when full of cards look like ordinary books they may be arranged like them on the shelves, and as they can be made very cheaply the catalogue of a library may be split up into hundreds of volumes, which will thus allow of its being consulted by many persons at the same time.

THE *Engineering and Mining Journal* has compiled its fifth annual volume on the mineral industry of the United States, giving statistics for the year 1896. The total value of the production was $706,015,411, an increase of $23,950,-293 over the preceding year. The United States in 1896 was the largest gold producer of the world and the largest silver producer; it was also by far the largest producer of copper, furnishing over one-half of the world's supply of that metal. Notwithstanding the decrease in the pig iron output it was still larger than that of any other country. In coal the total was still less than that of Great Britian, though it is gradually approaching the point where the two will be equal. The editor writes: "In accordance with our usual custom, we have added to the usual measurements of quantities in each case the metric measures, which we earnestly hope will soon be the only legal measure in this country, as they already are in nearly every other civilized country."

THERE was recently an interesting debate in the British House of Lords regarding works of art and the finance act. A clause in that act enacted last year reads as follows:

"Where any property passing on the death of a deceased person consists of such pictures, prints, books, manuscripts, works of art, scientific collections, or other things not yielding income as appear to the Treasury to be of national, scientific or historic interest, and is settled so as to be enjoyed in kind in succession by different persons, such property shall not, on the death of such deceased person, be aggregated with other property, but shall form an estate by itself, and while enjoyed in kind by a person not competent to dispose of the same be exempt from estate duty; but if it is sold or is in possession of some person who is competent to dispose of the same shall become liable for estate duty."

This clause it appears has been interpreted so as to include only works of art, illustrating English history. It is not clear whether scientific collections must also be confined to English history in order to be exempted from death dues. It was claimed in the debate in the

House of Lords that the tax leads to the dispersion of art collections, pictures being exported from England to the value of $6,000,000 annually.

The *British Medical Journal* states, on the authority of the Secretary of the Pretoria Agricultural Society, that Professor Koch's results with rinderpest inoculation are better than usually stated to be. He says that the method carried out in hundreds of instances has proved successful, but the unfortunate part has been that the ignorant Boer has not carried out all the particulars as instructed. He knew of one instance in which a Boer, after inoculating an animal with the virus, actually cleaned his fingers on the back of the nearest one grazing. In his opinion, however, it is not quite possible to stamp out the disease by the method, as it is impossible to inoculate throughout South Africa the hundred thousands of heads of cattle belonging to the natives in isolated districts in various parts of the country, and this contagious virus is, moreover, carried by the aasvogels (a species of vulture), who feed on the carcasses and carry the rinderpest from farm to farm.

It is stated in *Nature* that a botanical society has recently been established at Perth, West Australia, and has been given the designation of the Mueller Botanic Society, as a tribute to the memory of the late Baron von Mueller, who spent the best part of his life in investigating the plants and other products of Australia. Sir John Forrest has been elected President of the new Society; Mr. Wittenoom and Mr. Leake, Vice-Presidents, and Mr. Skews, Secretary.

The Auckland Institute, says *Natural Science*, has decided to add a new hall, 50 feet square, to its Museum, on the east side of the Ethnographical Hall. It is intended to receive the statuary presented by Mr. T. Russell, which has hitherto found an uncongruous home among stuffed vertebrates. The space thus gained will be occupied by groups of the larger mammals, and £100 offered by Mr. Russell will be used to procure a group of the larger carnivores. Little Barrier Island, on which an attempt is being made to preserve the indigenous fauna and flora of New Zealand, has been placed under the control of the Institute, with a grant of £200 for the first year's expenses. Mr. R. H. Shakespear has been appointed curator, and it is hoped that he may be able to stop the depredations of collectors.

UNIVERSITY AND EDUCATIONAL NEWS.

It is announced that a college for women under the auspices of the Roman Catholic Church will be established at Washington. It will be called Trinity College, and will be adjacent to the Catholic University of America.

The municipal council of Marseilles has passed a resolution favoring the establishment of a university in that city.

Mr. C. L. Herrick, lately professor of biology at Denison University, has been elected President of the Territorial University at Albuquerque, New Mexico.

Dr. A. R. Hill has been appointed professor of psychology and ethics in the University of Nebraska, and Dr. E. L. Hinman has been promoted to an adjunct professorship of philosophy in the same University.

Miss Bertha Stoneman, who has been engaged for several years in the study of the development of fungi in the botanical department of Cornell University, and who received last year the degree of Doctor of Philosophy, has been appointed professor of botany in the Huegenot College in Cape Colony, South Africa. This is a college for the education of the daughters of the French and Dutch Huegenots and English residents in South Africa. She sails from New York on Saturday, July 24th, for Liverpool, and thence by the British African line of steamers for South Africa.

Miss Arma Anna Smith, M. S., and Miss Ethel Muir, Ph.D., both of Cornell University have been appointed assistants in Mount Holyoke College, South Hadley, Mass., the former in botany and the latter in philosophy.

Miss Ellen Hayes, for the past nine years professor of mathematics in Wellesley College, has just been made professor of applied mathematics in the same College. The courses of

study conducted by Miss Hayes include mechanics, thermodynamics, geodynamics and theoretical astronomy.

PROFESSOR HUGO DE VRIES, of Amsterdam, has been called to the chair of botany in the University of Würzburg as successor to the late Professor J. Sachs. In the same University, Professor Ph. Stohr, of Zurich, has been appointed professor of anatomy in succession to Professor v. Kölliker, who will hereafter confine himself to histology and embryology. Dr. Salomon has qualified as docent in geology and mineralogy in the University at Heidelberg.

DISCUSSION AND CORRESPONDENCE.

NEW TERMS IN GEOLOGY.

PROFESSOR DAVIS, speaking in behalf of new terms in geology and geography (SCIENCE, July 2, p. 24), makes the following points: that new terms are necessary to any advancing science; that new things and new ideas must have new names, and that the investigator must be left as free to name his conclusions as to reach them. He mentions some terms introduced by Powell in 1874 as examples of useful ones, and others of later introduction which he expects to see survive; at the same time he admits that he has been not a little amused at watching the rest of us 'wrestle' with new terms.

These contentions seem at first glance to be altogether reasonable. But that new terms are demanded by an advancing science is admissible only in a limited sense. The discovery of new elements, new materials, new biologic forms, all call for new names. To these no one thinks of objecting. Aside from such cases, what book published in the last fifty years has contributed more than any other to the advance of science all along the line? Darwin's 'Origin of Species.' And how many new terms did Mr. Darwin use? Not one—if we except such an expression as 'natural selection.'

The newest science of which I have any knowledge is that now being remarkably developed by Dr. Charles H. Gilbert, of Stanford University, in studying geographic and geologic changes by means of the fish faunas. And I venture to say that his splendid results will eventually be brought forth, not dressed in the paraphernalia of a new terminology, but without the use of a single new expression.

It certainly does not follow, then, that an advancing science and new ideas must, of necessity, have new names.

As for freedom to name one's conclusions, I would ask: Is this naming a matter that concerns the finder alone, or does it concern every one who has to do with the science? Are facts and conclusions private property to be named, like one's dog, as the owner happens to fancy, or are they a part of science, and to be named with some reference to those who may have to use them?

Mention is made of certain geographic terms that are expected to prove useful. I may specify one of these—*Cuesta* (Spanish for the flank or slope of a hill, but also used for a hill itself)—as the kind of a word which, in my opinion, is not demanded either by the necessities of an advancing science, or as representing a new idea. And if we see fit to name one kind of a hill *cuesta*, with just as much reason we may baptize with new technical names all the different parts, kinds, sizes and shapes of hills on the face of the earth, while students may be asked to fill their bellies with these husks of science under the impression that they are necessary parts of the science itself. Everyone remembers the story of Agassiz setting a new student to study a case of birds, and how, when he reported a few hours later that he knew all of their names, he was told to forget the names and to go back and study the birds.

But the main point is whether such things advance knowledge or serve important purposes in that advancement. When Mr. Gilbert described certain structural features of deep-seated igneous rocks he advanced our knowledge, and when he gave us a rational name by which to call those hitherto unknown forms he gave us a label for that knowledge. But it hardly follows from an instance of this kind that forms and structures that geologists have long known and comprehended should be given new names either from the Spanish or from any other language. We shall not understand a synclinal mountain any better by calling it a 'Shickshinny.' It is hardly a case of new bottles needed for new wine.

Terms that save men's time and nervous energy are helpful and welcome; those that consume time and energy without adequate return are 'useless incumbrances.' For this is a pretty busy world, and as many of us are anxious to keep pace with what is going on in geology and geography we often feel impelled to say to contributors, as we do to callers at the the office during business hours: "Be plain; be brief."

Local names serve good purposes with students who are obliged to get their ideas of geology from local illustrations, but such names should be kept at home; in the general literature of the subject they are what the European geologists call them.

One's feeling the need of a new term, or his having found one 'serviceable in his lectures during the past winter,' are certainly not of themselves sufficient reasons for introducing them to the public.

Technical names are a necessary evil, and new ones cannot be avoided; but it is our duty to increase this evil as little as we can, and only after duly weighing the pros and cons of each case. JOHN C. BRANNER.

STANFORD UNIVERSITY, CALIFORNIA,
July 12, 1897.

NOTES ON SOME FOSSILS OF THE COMANCHE SERIES.

THE description and figure of *Turritella leonensis* given by Conrad in the Report of the Mexican Boundary Survey implies that all of the whorls of the shell in that species are rounded. In my 'Description of Invertebrate Fossils from the Comanche series in Texas, Kansas and Indian Territory' (Colorado College Studies, V), I described *Turritella denisonensis* from the Choctaw limestone of northern Texas, noting its resemblance to *T. leonensis*, but separating it from that species on the ground of the much enlarged and angulated, or shouldered, body-whorl. In 1895 Mr. R. W. Goodell brought some fragmentary but interesting specimens of *leonensis* from the Trans-Pecos region of Texas, whence came Conrad's types of the species. One of these shows the body-whorl to be enlarged and shouldered as in *denisonensis*. I therefore suspect the latter to be a synonym of *leonensis*. As the northern specimens have been found in both the Choctaw and Grayson members of the Denison formation, while there is reason to believe that Mr. Goodell's specimens are from the Washita formation, it is probable that *Turritella leonensis* ranges throughout the entire Gainesville division.

In 1893, in the Fourth Annual Report of the Geological Survey of Texas (Part II., page 232), the writer noticed a shell that had been collected by Mr. L. S. Williams from 'drift,' in northern Texas, briefly characterizing it as a variety of *Turritella seriatim-granulata* and assigning to it the name *ventrivoluta*. Our first positive knowledge of the stratigraphic place of this shell is afforded by a fine specimen which the writer found in 1893 (only a few months after the original notice of the shell had been published) near Belvidere, Kansas, in the lower part of the Kiowa shales, viz., the Fullington beds, which correspond more or less nearly with the Kiamitia of Texas. The specimen is complete, and the half which is free from the matrix affords an apertural view of the shell in its entire length. The ornamentation is well preserved and, taken in connection with the other characters, shows that the shell is very distinct from *T. seriatim-granulata*. Like the latter species, it belongs to the subgenus *Mesalia*, and should be known as *Turritella* (*Mesalia*) *ventrivoluta*.

Turritella belviderei, sp. nov.—Shell of medium size in the genus, consisting of ten or more flattened or somewhat convex whorls; suture feebly impressed; aperture round-rhombic, slightly elevated; whorls ornamented with about six subequal to unequal, abruptly elevated revolving ribs whose summits are beaded, each bearing a rather closely-set series of oblique to transverse prominent granules; the intercostal intervals square-bottomed, those of the upper spire-whorls and of the lower parts of the body-whorl and first spire-whorl wider than the ribs, those of the upper parts of the body-whorl and first spire-whorl respectively less than and about equal to the ribs; upper rib and tubercles of each whorl usually coarser than the others, especially so in the case of the body-whorl, in which the large tubercles are sometimes distinctly arcuate (concave on the side away from

the aperture), an attenuated rib, or raised line, (sometimes two) developed just above it, about on the suture, the second rib above this being also sometimes smaller than the average.

Measurements.—Hight 45 to 60 mm.; breadth of body-whorl 17 to 20 mm.; divergence of spire-slopes (variable) commonly between 18 and 23 degrees.

Occurrence.—In the Kiowa formation at Belvidere, Kansas. It is the common Turritella of this formation, and is very abundant and well preserved in limestone bands in the Fullington horizon at that locality. Specimens preserved in the carbonaceous clay-shale parts of this horizon are usually found crushed.

This shell has hitherto been cited generally under the name, *Turritella seriatim-granulata*, but is distinct from that species as described and figured by Roemer.

I have elsewhere listed as '*T. marnochi*' and '*T. seriatim-granulata*, var. *marnochi*,' a large Turritella which is common in the Champion shell-bed at Belvidere. Recently, I submitted to Mr. T. W. Stanton, of the United States Geological Survey, specimens of the shell so listed. Most of these were returned without comment; but one, whose only differences from the others seem to fall within the individual variation of the species, was returned with the comment, "This specimen is more like Roemer's type of *seriatim-granulata* than any other I have seen, the chief difference being its larger size. Comparison was made with a squeeze from the original." Since all of these specimens agree in general character of ornamentation with *seriatim-granulata* as represented by Roemer in his Kreidebildungen von Texas, and since, at the same time, there is in many of them a tendency to that elongation of the granules which Dr. White represents for his *Turritella marnochi*, it seems altogether probable that the original *marnochi* and the large Turritella of the Champion shell-bed that I have hitherto referred to *marnochi* represent one and the same species, the *Turritella seriatim-granulata* of Roemer.

A careful study, recently made, convinces me that the common *Turritella* of the Kiowa shales, to which, in Bulletin No. 11 of the Washburn College Laboratory of Natural History, I applied the varietal name, *belviderei*, should be recognized as a species distinct from *seriatim-granulata*, and I have accordingly described it as such under the name thus early applied to it.

Omitting common points, the two species may be characterized for determinative purposes as follows:

T. seriatim-granulata. (Including *T. marnochi*, apparently as an individual variation.)

Size large; granules mostly well interspaced, coarse, appearing as small, low, rounded tubercles, or elongate with the trend of the revolving costellæ, both forms of granules often appearing on the same specimen and in variable proportion.

T. belviderei.

Size usually smaller; granules finer, prominent, numerous and crowded, their greatest diameter either transverse to costellæ or oblique.

So far as I am aware, there is no conclusive evidence of inter-gradation of the two types, though there is variation in both.

But here arises the question of the relation of *Turritella belviderei* to Meek's *T. kansasensis*, of the Mentor beds. The latter species, which attains a much larger size than is credited in the original account of it, is described as if ornamented with simple linear revolving ribs. As usually indicated by the mould, it is so ornamented; but in some instances there are traces of granules on the ribs, though only of feeble ones so far as yet observed. Aside from their summit-form, the ribs have the same characters as those of *T. belviderei*, viz., abrupt elevation, square-bottomed intervals, etc. The sinuous trend of the growth-lines in this species is found also in *belviderei* and *seriatim-granulata*. *T. kansasensis*, as now known, has the ribs plain or nearly so. But the moulds sometimes seem to be coated with a ferruginous film which may have obliterated distinct granules if such were originally present; and the query arises whether new and better material might not show strongly granulated ribs, and *belviderei* so become a specific or varietal synonym of *kansasensis*. At the same time, it is certain that in many Mentor fossils the moulds preserve the impress of the surface-sculpture in its finest details.

An apparent difference of ornamentation like that between *Turritella kansasensis* and *T. belvi-*

derei exists between the Mentor fossil, *Margarita mudgeana* Meek, and the Kiowa species, *M. marcouana* nobis; and here also it remains to be shown whether the difference is genuine or due to unlike conditions of preservation.

I have recently identified *Nerinea acus*, Roem., from the Champion shell-bed at Belvidere, the markings shown as in Roemer's figure of the type. This, with the *Lithophagus* noticed below, brings the total number of Invertebrata known from this thin but remarkable shell-bed up to thirty-eight. This interesting occurrence of *Nerinea acus* further confirms Professor Hill's earlier and my own constant later reference of the Champion shell-bed to the Fredericksburg formation, and to the Comanche Peak limestone in particular; and the occurrence of the *Lithophagus* in both the Champion and the Kiowa not only adds to the former evidence of a closely successional time-relation of the two formations, but also tends to emphasize the conclusion I have elsewhere announced, that the Kiowa is about equally related to Fredericksburg and Washita.

The *Lithophagus* referred to is one of which I found several specimens in burrows in Serpula-knots in the Champion shell-beds, and which is assumed not to differ specifically from the '*Lithophagus* sp. nov.' of Stanton, reported (in Hill's 'Outlying Areas of the Comanche Series in Kansas, Oklahoma and New Mexico;' Am. Journ. Sci. 3rd Series, Vol. L), as occurring in Gryphæa-valves in the Hill and Gould collections from the Kiowa shales at Belvidere, borings similar to those in the Serpula having been found by the writer in Gryphæa-valves at the zone of transition from the Black Hill shale to the Fullington bed, a horizon intermediate in position between the two which have yielded the actual shells of *Lithophagus*.

In 1893 I collected in the Comanche Peak limestone of south-central and north-central Texas several specimens of an apparently undescribed, heavy-ribbed species of *Cyprina*, to which I have given the manuscript-name *Cyprina laticostata*. I now recognize as belonging to this new species the cast which, in my 'Study of the Belvidere Beds,' I referred to *Homomya alta*, Roem. Thus the evidence for reference of the Champion shell-bed to the Comanche Peak limestone of the Fredericksburg division continually becomes clearer.

Stratigraphic Names for Caprina and Caprotina (or Requienia) Bearing Beds of Northern Texas. In defining the Barton Creek limestone, a member of the Fredericksburg formation (*American Geologist*, XVI., 385), I fell into the error of including in it both the Caprina limestone and the Caprotina limestone of Shumard, whereas it was the former only (whose fauna includes both *Caprina* and *Caprotina*, or *Requienia*, with other genera of *Chamidæ* and *Hippuritidæ*) that should have been included in the definition, and which was especially intended, this being the limestone that succeeds the Comanche Peak limestone, on Barton creek, in Travis county, Texas. It is the cap-rock of a number of buttes that carry remnants of the Fredericksburg formation in central and western Texas. The Caprotina limestone of Shumard is the Caprotina or Requienia bed that occurs in the upper Glen Rose, in the Brazos Valley, in the vicinity of Granbury, and which may be designated as the *Granbury bed*, to distinguish it from more or less similar beds elsewhere. Since proposing the name Barton Creek for the Caprina limestone of the creek thus named, I have observed that the name is quite similar to that of the Barton clays (Tertiary) of England. The similarity is the more unfortunate because increased by my inadvertently referring to the Texas bed in a shorter form, 'Barton,' in formally defining it, immediately after having defined it in table as 'Barton Creek.' Altogether, the considerations stated probably render either 'Barton' or 'Barton Creek' untenable, and both terms are therefore here abandoned in favor of another. The same bed of Caprina limestone that occurs on Barton creek may be seen overlying the Comanche Peak limestone, in Stonewall county, Texas (where, as Messrs. Dumble and Cummings have shown, and as the present writer has later observed, it forms the cap-rock of Double mountain); and the name *Stonewall limestone* is therefore here proposed for it.

F. W. Cragin.
Colorado College, Colorado Springs, Col.,
May 28, 1897.

OYSTERS: A REVIEW OF IGNORANCE.

ONE of the greatest services which science is doing for the world is the exposure of ignorance, and the inculcation of the doctrine that a thorough groundwork of the rudiments of general science should be laid by those who aspire to teach or to practice medicine, and it should be appreciated by the public that those alone who possess it are worthy of confidence.

In illustration of the actuality of the need, and partly as a review of the question concerned, I will criticise a leading article contained in a journal called *Modern Medicine and Bacteriological Review*, which purports to show that the oyster must be abandoned as a food.

This article begins by reciting the plenteousness of bacteria in the oyster, and says it is "a creature whose diet consists of the offal of the ocean, and which lives upon material so filthy and noxious in character that it requires the unceasing activity of a liver constituting nearly one-half the bulk of its body to protect it from impending death." It then cites the cases of typhoid fever traced to the oyster, quoting the *British Medical Journal*, which comments on the need for supervising the oyster beds; and then the editorial remarks that the beds are usually seated in the mouths of rivers and bays: "The oyster is fond of typhoid bacilli; it eats them as a tidbit; it will not miss a chance of swallowing millions of these mischief-making germs if opportunity is afforded. Indeed, this is the very business for which nature designed the oyster. It feasts upon the slime and ooze which covers the ocean's bed, near the shore, and the seaweeds which grow in such localities. The oyster has neither teeth nor claws with which to tear and masticate solid food. It is designed to live on the decomposing germ-infected substances which, with its filmy beard, it wipes off the slime-covered weeds and stones which abound in oyster beds."

The writer of this screed, posing as a bacteriologist and zoologist, seems to be ignorant alike of both sciences. We can here get an idea of the amount of harm which can be done by *soi disant* teachers through the medium of alleged scientific journals.

It is in the first place evident that this writer is ignorant of zoology. He does not know how the oyster feeds; he thinks it wipes its food off the weeds with its beard! I have seen some individuals use their beards for dinner napkins, but the oyster's is truly useful; it is fork and spoon, too, it appears! Every student of natural history should know that the oyster's beard or ctenidia is his gills; that he feeds by drawing a current of water by ciliary action mainly of the ctenidia into his mouth and lives on the solid particles which are contained in the water, and that the so-called liver is a digestive gland.

Furthermore, the oyster is plainly not designed by nature for a scavenger. His natural habitat is on a clean rocky bottom, and not in the mouth of a river, as fresh water is injurious to him, consequently he cannot live on slime and ooze. When oysters are 'parked' into a muddy or even a sandy bed they do not thrive at all.

After this display of biological ignorance one wonders if the writer, presumably a doctor, can tell a mollusc from a worm.

Now, as to the bacteriology of the matter, it is plain that if the oyster feeds on typhoid bacilli he must assimilate them, and when living things are digested they generally die during the process, consequently when we eat an oyster we do not eat live bacilli. But they can live in the stomach and gut a long time, also other enteric parasites.

It is an unquestionable fact that typhoid fever could not be caused by the introduction of any number, even millions, of dead bacilli into the human body, but, at the most, some temporary illness from the ptomaines in the mixture.

Finally, the 'Medical Progress and so forth' assumes that the oyster's large liver, which, as stated above, is not homologous to the liver, is a poison trap. I was not aware that this was the main function of an hepatic cell. Plainly, the primary deduction from a large liver would be that metabolic processes were complex and that nutriment needed to be stored in large quantity. The oyster's liver, however, does not seem much different from those of his congeners.

All this sensational essay of ignorance will doubtless be reproduced by the small-fry medical journals and the daily press. It must contribute toward hurting the oyster industry. It

must result in many invalids being deprived of a luscious and digestible food, and last, but not least, help to belittle science by reasoning which the common sense of centuries shows to be absurd.

Contrast all this with the calm attitude of the scientific *British Medical Journal*, which contents itself, according to the quotation from it, with calling for scientific investigation of the reason for some beds being polluted.* It seems quite likely that isolated oyster beds might be contaminated with bacilli, but the natural history of the oyster shows that he could not exist under such conditions, and that the bed would die out. In fact, the danger will apparently regulate itself.

I hope that these remarks will draw the attention of practical biologists, competent to set the question at rest; at the same time they will serve to show the great need of at least an elementary knowledge of science among our doctors before they presume to settle questions of the food supply of mankind; and they will serve to show the great lack of that knowledge among the rank and file of practitioners, who, at any rate, 'out west,' appear rather to glory in it.

GEORGE CHAS. BUCHANAN.

* *Cf.* The investigations by Professor Conn, of Wesleyan University, and of Professor Herdman, of Liverpool College.

CEREBRAL LIGHT.

IN darkness or with closed eyes we can always see irregular forms of light in our visual field. These forms are of various kinds, series of waves, successive rings that spread and break, etc. In addition to these definite figures there is always more or less definite irregular illumination over the whole field. These phenomena are generally called the 'retinal light' or the '*Eigenlicht* of the retina.' They are usually supposed to arise from chemical changes going on in the retina. I wish to record some observations that apparently prove them to be cerebral and not retinal processes.

1. With closed eyes there is only one illuminated field, not two, as there should be from the two retinas if the light were retinal. Two retinal figures might appear as one under the conditions: (*a*) Of suppression of one field, which is not the case here, because it is impossible to keep one field suppressed for many minutes, whereas I have watched the retinal figures in uninterrupted continuance for a long time; (*b*) of perfect identity of form, which is hardly a possible supposition in the case of these irregular, volatile, chemical phenomena; (*c*) of sufficiently similar construction for union by stereoscopic vision, which also is not the case, as there is no relief effect in the picture.

2. The figures do not change in position when the eye is moved. They are localized in front and remain in the same place, even if the eyes are directed to one side. I find, however, that if the eyes are turned to a new position and kept there, the central figure (a spreading violet circle with a phosphorescent rim) will soon afterwards follow the movement; there is thus a tendency for this figure to occupy the spot of sharpest vision.

3. The figures do not change in location when the eyes are displaced. When the eyes are looking at some definite object, *e. g.*, this page, a pressure of the finger on one of them will cause the page apparently to move. This is true whether the other eye is open or closed. Likewise, if an after-image is obtained, it will move upon pressure of the eyeball. The pressure displaces the eyeball and changes the projection of the retinal picture. This displacement does not occur with 'retinal light.' I have repeatedly observed these figures and have manipulated the eyeballs; I have found that they are not in the slightest degree affected by the manipulations. In order to avoid all possibility of errors of observation, I have made the experiments in a series alternately with eyes open and eyes closed. With the eyes open I observed a dimly illuminated window; with them closed I saw the 'retinal' figures. The former always followed the displacements, the latter never.

These observations are, I believe, sufficient to establish the proposition (which I have not seen elsewhere) that the phenomena of vision usually known as 'retinal light' and 'retinal figures' are not originated in the retina, but in the brain. They should therefore be termed 'cerebral light' and 'cerebral figures.'

The following hypothesis seems also justified:

The cerebral light is located in those higher centers of the brain which are connected with visual memories and imaginations. While watching the cerebral figures I find that my visual memories or phantastic figures appear in the midst of the cerebral light and frequently cannot be distinguished from them. The close connection of these cerebral figures with the contents of dreams has been repeatedly noticed by Johannes Müller and a series of later observers. There is also the possibility that the hallucinatory visions produced by hashish, mescal and other drugs may be simply modifications of this cerebral light.

E. W. Scripture.

Yale University, May 21, 1897.

SCIENTIFIC LITERATURE.

Grundriss der Entwickelungsgeschichte des Menschen und der Säugethiere von Dr. Med. Oscar Schultze. Bearbeitet unter Zugrundelegung der 2. Auflage des Grundrisses der Entwickelungsgeschichte von A. Kölliker. Leipzig, Engelmann. 1897. 8vo. Pp. vii + 468.

Kölliker's well known manual has been so thoroughly reworked by Professor Schultze that it is essentially a new work. In Kölliker's volume the embryology of the chick furnished many of the descriptions and illustrations. Schultze has omitted the chick altogether, confining himself strictly to mammalian development, and has added a comprehensive though very condensed account of the fœtal membranes and placenta in the chief groups of mammals. Many new and admirable figures have been added, of which a considerable majority are original and taken from the author's own preparations.

It is exceedingly difficult to characterize Professor Schultze's text-book fairly, for it combines superior merits with conspicuous and singular defects. It is utterly inadequate as a presentation of contemporary embryology, for it systematically neglects the morphological, phylogenetic and mechanical aspects of embryology, and consequently reads almost like an old-fashioned descriptive anatomy. An embryological writer might be excused for avoiding phylogenetic and mechanical themes, but the neglect of morphological considerations makes full success in writing a text-book an impossibility. To illustrate these criticisms it suffices to examine the account of the nervous system; in the development of this the history of the neuro blasts and of the division of the medullary tube into dorsal and ventral zones are the fundamental facts morphologically, but our author barely describes the neuroblasts, does not figure them at all, and makes no allusion to the two zones, which should form the basis of the whole account, for without understanding these zones no student can master even the rudiments of our present knowledge of the brain and spinal cord. Again, the epidermis is equally maltreated, for the history of the epitrichium is incorrect, and no mention whatever is made of the fact that the nails are modifications of the stratum lucidum. Erroneous are also the accounts of the development of the glands in the stomach, which do *not* develop in the same way as those of the intestine; misleading is the history given of the supra-renals, for the so-called medulla of the organ in the human species is not derived from the sympathetic *Anlage*. There are mistakes in the illustrations: in Figs. 194 and 195 the 'Zwischenhirn' (Diencephalon) is correctly designated, but in Figs. 217 and 263 the same division of the brain is called 'Mittelhirn' (Mesencephalon); in Fig. 327 the left side of the heart is called '*rechte* Kammer' and the right side '*linke* Kammer,' while the great vein is labeled 'Sympathicus!' Of the index complaint must be made: one searches it in vain for Hirnblasen, Nerven, Thyroidea and other headings.

In spite of these criticisms, which indicate that the usefulness of the book is severely limited, the manual remains one of many merits and of great value. The author is felicitous in his combination of brevity and clearness, and in avoiding cumbrous accumulations of details. The faulty illustrations are exceptions; very good ones indeed are the rule, good both in selection and execution. In printing them the publishers have sustained their high reputation in this regard. The author has studied at first hand, and is thereby enabled to make his descriptions fresh, vivid and interesting, and if he had included in his point of view

the recognition of relative morphological values he would have prepared a work of signal utility. The student who uses the 'Grundriss' as his guide may acquire a fair knowledge of the empirical facts of embryology, but he will still have to learn the morphological interpretation of these facts and their relative importance. Meanwhile he will have profited by better, more available and more matter-of-fact descriptions of the anatomy of embryos than can be found in perhaps any other of the smaller text-books of embryology.

C. S. MINOT.

Das Süsswasserplankton, Methode und Resultate der quantitativen Untersuchung. Von DR. CARL APSTEIN, Kiel, Zool. Institut. Mit 113 Abbildungen. Kiel und Leipzig, Verlag von Lipsius & Tischer. 1896. 200 pp., 5 Tabellen.

To Dr. Apstein, of the school of planktologists at Kiel, is to be given the credit of applying the methods employed by Professor Hensen in his investigations in the Baltic and North seas, and on the '*National*' Expedition of 1889, to the quantitative investigation of the plankton of fresh water. His field of operations has been the lake region of Holstein. The book contains a full report of the results of the quantitative, and to some extent the qualitative, examination of more than 300 collections made in 15 different lakes during 1890–1895. A description is given of the apparatus, methods of collection, of determination of volume, and of enumeration of the constituent organisms or planktonts, if we adopt the term recently introduced by Schröter. There is, unfortunately, no adequate discussion of the margin of error which the methods involve. An annotated list of the important limnetic organisms is given with data on the seasonal distribution, abundance with dates of maximum and minimum occurrence and reproductive activity, with other facts of œcological import. Many of the forms are illustrated by reproductions from original microphotographs by the author. The microscope in the hands of the skillful operator reveals vastly more than the ordinary microphotograph records. For the purposes of scientific illustration of organisms of the plankton, and especially in such a book as this, it seems undesirable to substitute a method which rests upon the relative opacity of tissues simply, for one based upon the clear interpretation of the trained observer. One has only to contrast Dr. Apstein's best results in this line with the figures he reproduces from Hudson and Gosse, and Lauterborn, to appreciate the superiority of a carefully made drawing in conveying to the inquirer details of structure, and even such features as contour, proportion and natural position of parts. The book is not a manual of the limnetic fauna and flora, and the novice and casual student must still depend upon monographs and the widely scattered literature of the subject for aid in the determination of the planktonts. It is, however, an epitome of the subject, indispensable to every planktologist and a valuable aid to every student of fresh-water fauna.

Our author distinguishes active, passive and tycho-limnetic forms among the planktonts. With the latter he places *Difflugia*, whose presence in the open water is attributed to gas vacuoles, which cause it to rise from the bottom, its true habitat. *Difflugia* is a very abundant and important member of the plankton of our own great lakes, where it occurs in association with *Codonella*, *Dinobryon* and other typically limnetic forms. It also occurs in the Illinois river and its adjacent waters throughout a considerable part of the year, but in the open water and not upon the bottom. The conditions of the occurrence are such as to place it among the active members of the plankton rather than among those which owe their presence to the accidents of wind and current.

Following up the line of his earlier work, Apstein brings forward a long series of observations in proof of the equal horizontal distribution of the plankton in a body of water. In 80 catches the greatest departure from the mean was 22.8%, and the average departure but 5.52%. These hauls are distributed in short series of 2–5 parallel catches in various lakes, but the distance separating the successive collections is not given, and in no case has a lake been subjected to a larger number of examinations made upon the same day at frequent and regular distances throughout its whole extent. It seems

not improbable that such an examination would enlarge somewhat the variation in distribution as above given. Indeed, in another connection Apstein cites four catches made in Dobersdorfer See upon the same day, in which the variation from the mean is 100% or more, in three instances out of the four. This wide variation is, however, explained by our author as due to the presence of intervening sand bars in the lake. The results of counting individuals of various species in the plankton taken on the same day at different localities show a uniformity less marked than that indicated by the volumetric determination. There is no indication whatever of the presence in the plankton of 'swarms,' which Apstein defines as a local accumulation of animals of one species in one locality while the surrounding area is slightly, or not at all, peopled by it. This uniformity in the horizontal distribution is due to the similarity of the chemical constituents in the water, resulting in a uniform growth of the phyto-plankton and the zooplankton depending upon it. It is thus primarily a matter of food relations.

The vertical distribution of the plankton was determined by the subtraction process, and is subject to the error produced by the progressive clogging of the net. It seems very desirable that this problem be attacked by the pumping method. Apstein's results indicate the accumulation of the greater part of the plankton in the surface stratum of 0–2 meters, in which from 1½ to 60 times as much plankton is found (per cubic meter) as is present in a similar volume in the water below a depth of 2 meters. In this particular his results are in harmony with those of Reighard, Ward, and Birge upon our own lakes. Most organisms prefer the surface waters, only a few rotifers and *Entomostraca* actively seeking the deeper and colder strata. The vertical distribution of many forms, especially among the phyto-plankton, is closely linked with the life cycle. The maximum numbers occur in surface waters, and as these decrease and resting stages appear, they seek the deeper water, to increase again and rise to the surface as the maximum returns.

Apstein still maintains that plankton-rich and plankton-poor waters are characterized by the predominance of the *Chroöcococaceæ* and *Dinobryon* respectively. Reighard has shown that these criteria cannot be adopted for Lake St. Clair, and later work is making it still more evident that waters may be rich or poor in plankton quite irrespective of the conditions attending such diversity in the lakes of Holstein. The suggestion that plankton-rich waters are occasioned by the abundance of water-fowl is of questionable value, though local data may seem to support it.

Only those familiar with the routine of plankton investigation can appreciate the vast amount of work which Apstein's book represents, though his results will command the attention of everyone interested in the œcological side of biology. The science of fresh-water planktology is still in its infancy; its methods are as yet imperfect, and its problems are so intricate that years of continuous investigation in a number of localities will be required to establish broad generalizations. Dr. Apstein has been a pioneer in the field, and the great value of his work lies in its exploratory character and in his suggestive mapping out of the problems of planktology.

C. A. KOFOID.

UNIVERSITY OF ILLINOIS.

GEOLOGIC ATLAS OF THE UNITED STATES. FOLIO 25, LOUDON, TENNESSEE, 1896.

THE Loudon folio, recently published by the U. S. Geological Survey, represents that portion of the Appalachian province which is situated between the parallels 35° 30′ and 36° and the meridians 84° and 84° 30′. This area contains 968 square miles, divided between Blount, Monroe, Loudon, Knox, Roane and Morgan counties of Tennessee.

The folio consists of a topographic map, a geologic map, structure sections, stratigraphic sections, a map of the economic resources, and descriptive text. The author is Arthur Keith.

The text begins with a general description of the Appalachian province and points out the relations of this part to the others, with regard to its surface features. The local features of the drainage by the Tennessee river and its tributaries, Emory, Clinch, Tellico and Little Tennessee, follow next in description.

The various forms of the surface are pointed out, such as the Great Valley of Tennessee and the portions of the mountain district and the Cumberland Plateau, by which it is bounded, and the relation between these forms and the underlying rocks is made clear.

Under the heading 'Stratigraphy,' the geologic history of the Appalachian province is presented in outline, and the local rock groups are fully described in regard to composition, thickness, location, varieties and mode of deposition. The formations, thirty-three in number, range in age from Cambrian to Carboniferous, far the greater part being Cambrian and Silurian. The mountain district is chiefly underlain by the Ocoee series, whose age is doubtful. Rocks of Carboniferous and Devonian age occupy two small belts on either side of the Great Valley, and Silurian and Cambrian strata are repeated in narrow belts along the Great Valley. Limestones, shales and interbedded sandstones make up the Silurian and Cambrian strata; sandstones and shales, with coal seams and a limestone near the base, constitute the Carboniferous, and the Ocoee rocks are conglomerate, sandstone, slate and limestone.

The details of the strata are graphically represented in the columnar section. The different manner in which the formations decay is discussed, and the dependence of the residual soils and surface forms on the nature of the underlying rock. Great changes occur in the formations of this region, and the Knox dolomite is the only one which is uniform throughout. The direction of change was exactly reversed between Cambrian and Silurian time.

In the discussion of 'structure,' after a general statement of the broader features of the province, two methods are described in which the strata of this quadrangle were deformed. Of these the extreme Appalachian folding, accompanied by faulting and metamorphism, is by far the most prominent and is about equally developed throughout the quadrangle. Faults, especially, are most strikingly exhibited here. Deformation by vertical uplift also is exhibited, but only in comparison with broad surrounding areas. In this quadrangle the Great Valley is at its narrowest, on account of the extreme shortening in deformation. The structure sections illustrate the sharp folds and frequent faults into which the strata were forced.

Economic products of this region are coal, variegated marble, red hematite, building stone, lime, clays, timber and slate. The outcrops of the formations containing these are illustrated on the economic sheet, together with the locations of the mines and quarries. The iron ore and slate are of minor importance now; the coal district is a part of the great coal basin of Tennessee, on the same formations as the chief mining center of the State; and the marble belts are a part of the principal productive region for that stone. Various conditions affecting the value of these deposits are pointed out, and the associations and availability of the building materials and timbers are discussed.

FOLIO 27, MORRISTOWN, TENNESSEE, 1896.

The Morristown folio, also recently published, by the same author, deals with that portion of the Appalachian province which is situated between the parallels 36° and 36° 30′ and the meridians 83° and 83° 30′. This area contains 963 square miles, divided between the counties of Greene, Cocke, Jefferson, Hamblen, Grainger, Claiborne, Hancock and Hawkins, all in Tennessee.

Included in the folio are topographic, economic and geologic maps, structure and stratigraphic sections and five pages of descriptive text.

After a description of the broader features of the Appalachian province, the local geography is analyzed. The various types of surface features are pointed out and their relations to the underlying rocks are shown. Local facts, such as elevations and the drainage by the tributaries of the Tennessee River, the Nolichucky, French Broad, Holston and Clinch Rivers, are detailed.

Under the heading 'Stratigraphy' the geologic history of the Appalachians is presented in outline. This is followed by a detailed account of the local rock groups in regard to their location, composition, thickness, variations and mode of deposition. The soils and forms of surface produced by each formation are discussed with the formations. Twenty formations are distinguished in this quadrangle,

ranging from Cambrian to Carboniferous, far the greater portion being Cambrian and Silurian. The rocks of Carboniferous and Devonian age are found only in two narrow belts in the ridge district and are represented by only four formations. Over the rest of the area Cambrian and Silurian strata are about equally divided. A great variety of limestones, shales and sandstones compose the Cambrian and Silurian rocks, shales and sandstones the Devonian, while only limestone appears in the Carboniferous. Great changes take place in the Silurian strata, and limestones on the northwest are represented by shales and sandstones at the southeast. The general character of the formations is graphically represented in the columnar sections, one being drawn for each of the two chief geologic districts.

In the discussion of structure, after a general statement of the broader features of Appalachian structure, the two types of deformation shown in this region are described, and instances are pointed out in the structure sections. In the ridge district the most prominent feature is the faulting, which has cut the strata up into long, narrow blocks and produced the characteristic ridge topography. Southeast of Holston River the rocks were deformed by close folds. Deformation by vertical uplift is also existent in this region, but it can be observed only in comparison with other and larger areas. In the structure sections most of the details of the different structures are shown.

Economic products of this region are marble, building stone, lead, zinc, lime, cement, clays and timber. The outcrops of the formations containing these are represented on the economic sheet as far as possible, together with the locations of mines and quarries. The principal industries are the production of zinc and marble; the timbers and water-powers are also of general importance. The various conditions which affect the development of these resources are discussed.

SCIENTIFIC JOURNALS.

AMERICAN CHEMICAL JOURNAL, JULY, 1897.

On the Decomposition of Diazo Compounds: By W. E. CHAMBERLAIN, G. F. WEIDA and W. BROMWELL. The three papers contained in this number of the journal on this general subject give the results obtained in the study of the action of methyl alcohol on certain salts of diazobenzenes and diazotoluenes. Chamberlain, following up the suggestion of Remsen and Dashiell, found that, while under ordinary atmospheric pressure the main reaction between methyl alcohol and paradiazotoluene nitrate consisted in the substitution of the methoxyl for the diazo group, yet when the reaction took place under diminished pressure the hydrogen reaction was more favored. With an increase in the pressure the product remained as under ordinary pressure. When sodium methylate is used, and when an alkaline carbonate is added to the alcohol, only the hydrogen reaction takes place. Beeson found that alkalies and zinc dust would not only cause the formation of benzene, by the decomposition of a salt of diazobenzene, but also of diphenyl. The author of this work was, however, unable to obtain any ditolyl from an analogous decomposition of diazotoluene, probably owing to some different conditions of temperature at which the reactions take place.

Weida has compared the results of the decomposition of the three nitranilines and aminobenzoic acids with methyl alcohol, with the results obtained by Remsen and Graham when ordinary alcohol was used.

In the case of the orthonitrodiazobenzene sulphate the only product was nitrobenzene; but the meta- and para-compounds gave a small amount of nitranisol beside the nitrobenzene. The salts of the diazobenzoic acid did not act as they did when treated with ordinary alcohol, but showed a tendency to give the alkoxy reaction. They all gave as the principal product the ethereal salt of the corresponding methoxy acids.

Bromwell followed the same line of research as Chamberlain, using, however, the ortho-compound where the latter had used the para. He found that the ortho-compound decomposes at a lower temperature and gives the alkoxy reaction as the other does. When orthomethoxytoluene was treated with cold concentrated sulphuric acid a monobasic sulphonic acid containing one acid residue was formed, and when it was oxidized the corresponding benzoic

acid was formed. A number of the salts of the acid were prepared.

On the Action of Potassium Hydroxide on Orthomethoxysulphamine-benzoic Acid: By CHAS. WALKER. When the sulphonic acid described in the last paper was converted into an amide and fused with potassium hydroxide the product was not, as was expected, the corresponding dihydroxy-benzoic acid; but, as the author has shown, orthoxysulphaminebenzoic acid. The change can be represented thus:

$$C_6H_3\begin{cases}COOH\\OCH_3\\SO_2NH_2\end{cases}\ldots\ldots\ldots\ldots\ldots C_6H_3\begin{cases}COOH\\OH\\SO_2NH_2\end{cases}$$

Several salts of the acid were also made and studied.

A Simple and Efficient Boiling-Point Apparatus for Use with Low- and with High-Boiling Solvents: By H. C. JONES. The author has modified the apparatus devised by Hite by making it longer and replacing the inner tube by a platinum cylinder. By these changes he claims to have avoided the errors caused by the cold liquid returned by the condenser coming in contact with the thermometer, and also those due to radiation of heat from the bulb of the thermometer. He also replaces the outer vapor jacket, so generally used, by a cylinder of asbestos. A number of results are given which were obtained with both high and low boiling solvents.

Aluminum Alcoholates: By H. W. HILLYER. As was stated in a paper published some time ago, the authors found that when an anhydrous chloride was added to aluminum in alcohol a rapid deposition of the metal and an evolution of hydrogen took place. Dry hydrochloric acid gas or a solution in alcohol will cause a rapid evolution of gas when added to the aluminum in alcohol, and if the action is once started it will continue for some time even if no more acid is added. When the solution cools a crystalline compound, probably an addition product of the chloride and alcohol, separates out. When stannic chloride and hydrochloric acid gas are used it is very important that the materials should be completely dehydrated, as the presence of a small amount of water will stop the reaction. The results seem to show that it is necessary, in order to get a satisfactory action of aluminum on alcohol, that it should be anhydrous; that it should contain an anhydrous chloride with which it can form an addition-product; and, that the aluminum should be coupled with a more easily reducible metal.

Behavior of Chloral Hydrate with Ammonium Sulphide: By J. LESINSKY and C. GUNDLICH. The authors found that a mixture of chloral hydrate and ammonium sulphide will, after a longer or shorter time, depending upon the temperature, form a dark precipitate. They suggest it as a possible test for the purity of chloral hydrate and propose to study the reaction and the product.

A New and Rapid Method for the Quantitative Separation of Iron, Aluminium, Chromium, Manganese, Zinc, Nickel and Cobalt: By A. R. CUSHMAN. This method, which is more rapid than those generally used, has been found very satisfactory; but no details can be given in a review, as it is already in the most condensed form possible. The following reviews are also given: A Resumé of Progress in the Chemistry of the Carbohydrates during 1896; Traité élémentaire de mècanique chimique fondu sur la thermodynamique, P. Duhem; Elektro-Chemische Uebungsaufgaben, F. Oettel; Theorie und Praxis der Analytischen Electrolyse der Metalle, B. Neumann; Le four électrique, H. Moissan.

J. ELLIOTT GILPIN.

NEW BOOKS.

La structure du protoplasma et les théories sur l'hérédité et les grands problêmes de la biologie générale. YVES DELAGE. Paris, C. Reinwald et Cie. 1895. Pp. xvi + 878. 24 fr.

Geological Survey of Canada. Annual Report, Vol. VIII., 1895. GEORGE M. DAWSON. Ottawa, S. E. Dawson. 1897.

A Popular Treatise on the Physiology of Plants. PAUL SORAUER. Translated by F. E. WEISS. London and New York, Longmans, Green & Co. 1895. Pp. x + 256.

Water and Public Health. JAMES H. FUERTES. New York, John Wiley & Sons; London, Chapman & Hull, Ltd. 1897. Pp. v + 75.

SCIENCE

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FRIDAY, JULY 30, 1897.

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THE VEGETATION OF THE HOT SPRINGS OF YELLOWSTONE PARK.

MUCH of the beauty of the so-called 'formations' of Yellowstone National Park lies in the brilliant tints of the mineral deposits, wet from the streams of hot water that issue from the thermal springs and geysers.

Formation is a general term employed to designate any mineral matter deposited by the geysers and hot springs. The amount of formation in the Park is extraordinarily large, but it is chiefly confined to four regions. At Mammoth Hot Springs there is an immense deposit of calcium carbonate, the sides of which are terraced with pulpit-like projecting basins, as is shown in figure 1.*

These interesting basins are formed by the activities of numerous hot springs upon the top and along the sides of the terraces. The entire pile of dazzling white mineral has been likened to the front of a glacier. The Norris Geyser Basin, the Lower Geyser Basin and the Upper Geyser Basin are similar to one another in certain respects. They are extensive expanses of formation chiefly silicious in composition. All of them are situated in the floor of a valley and cover acres on either side of the Firehole River, which flows between banks of snowy whiteness. Upon these formations are scattered the numerous mounds built up by the geysers, and here also are many clear pools of hot water. The latter are of various sizes, some mere shallow puddles which sizzle and sputter, but most of them deep basins with sloping sides, and one at least a pond a hundred yards wide. The water is almost always scalding hot, sometimes even boiling violently in the middle of the pool.

*Figures 1, 5 and 7 are taken from the Ninth Annual Report of the United States Geological Survey.

Dry formation is generally dazzling white, as pure and clear as any snow field of the Alps or Norway. Dry formation reflects the light from innumerable crystals and the rays all seem to focus upon the individual in the proximity. This is why the formation is so hot and blistering. This is why the kodak must be 'stopped down' to its smallest diaphragm if one desires to photograph the geysers, as many a tourist has learned to his sorrow when he viewed the dark brown, over-exposed film of some geyser in action, and then remembered the long wait in the glittering sunshine, the mad rush for favorable points of view and the supreme satisfaction that he felt when the exposure was indexed and described: 'Old Faithful from the west, sunshine upon the vapor clouds, fir forest in the background.'

Wet formation is usually colored. Wherever a stream of water flows from a hot spring the course is marked by streaks of green and yellow along its margin. Fringes and rims of green and gamboge border the boiling pools. Upon the sides of the pulpit basins (see Fig. 1) are flutings of red and orange, of green and brown. The sides and bottoms of the streams are lined with olive colored felts of a velvet-like consistency, and there may be green or brown stringy filaments waving to and fro in the hot currents of water. The sides of many of the pools are covered with green, leathery membranes, or smeared with a coating of structureless jelly. Even the hottest pools, those which are boiling violently in certain parts, are likely to have some of the colored fibrous or gelatinous deposits at their edges. The temperature of the water in these streams and basins is frequently above 80° C., and water boils in Yellowstone Park in the neighborhood of 92° C.

Almost all of this brilliant coloring is associated with growths of low forms of plant life. Some of these organisms it will be our purpose to describe, together with a discussion of certain activities manifested by them in connection with the structure and development of the formation. It is not difficult to see that the growth is various in character in different parts of the hot springs. One finds the most luxuriant masses in such portions of the streams as have cooled down to a relatively low temperature, that is where the water, instead of being scalding hot, may be simply unbearably warm.

Here, at a temperature of from 40°–50° C., flourish a variety of forms with the greatest display of color. The prevailing tints are green, but much of the growth is brown, red or frequently orange. The forms which the masses of vegetation assume depend upon the condition of the environment. If there is a rapid stream the bottom will be covered by a smooth, slippery, leathery felt, and perhaps occasional stringy masses attached at points along the sides and bottom will float out with the current. If water lies in a quiet pool one may find a thick growth of this felt-like character on the bottom and there will be numerous tufts perched upon projecting knobs of rocks. These tufts are made especially prominent by the bubbles of gas entangled in the network of filaments. The tufts are particularly interesting because they give rise to some of the most peculiar sculpturing of the shallow pools.

In warm water, at a temperature of from 55°–65° C. there is a preponderance of green growth, much of it a vivid emerald green. The color becomes less pronounced in warmer portions of the stream, fading to a yellowish brown, and finally becoming light yellow when the water approaches 80° C. in temperature. In the hottest water one finds only white filaments, which grow as long silky strings in the running streams or form a delicate cobweb upon the bottoms of quiet pools. This is the growth that marks

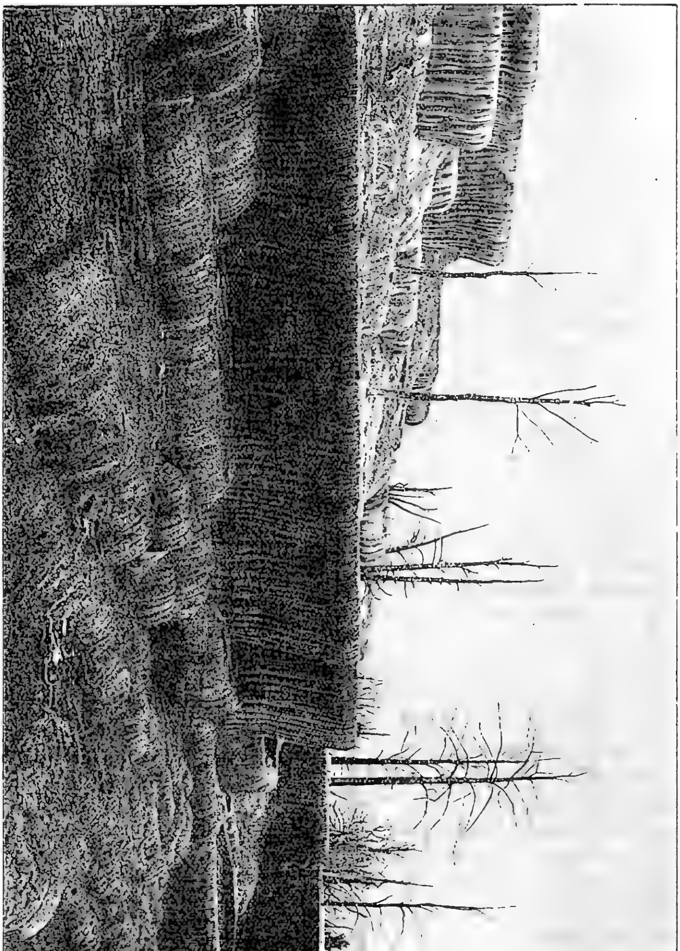

FIG. 1.—Pulpit Basins. Mammoth Hot Springs.

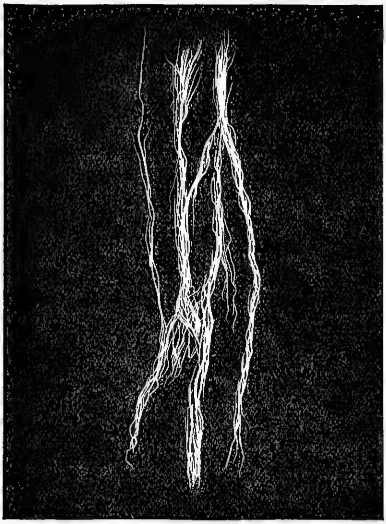

Fig. 2.

the limit of life in these hot springs, and it is not likely to be found in water warmer than 85° C.

Let us now consider the structure of some of the most striking types of plant life making up the vegetation of these hot springs. It would not be wise to go into details, and indeed I cannot well do so, for no one has ever published a critical study of these forms. The subject is really a very difficult one for several reasons. In the first place the organisms are all very minute and can only be studied under the highest powers of the microscope. The characters which define the species are particularly evasive because the forms are extremely simple in structure, and color and size are notoriously variable qualities among such organisms. Then these forms must be carefully compared with the inhabitants of other hot springs, particularly those of Germany and Italy, where such growths have been somewhat extensively studied. This is necessary in order to place the identifications upon a firm basis.

Naturally, the most interesting forms from our point of view are those living in the hottest pools. The growth is usually white or gray; much of it has a pearly luster, and the structure is filamentous. In quiet water it forms a delicate network on the bottom. In the little streams which carry off the overflow from boiling pools one may find the filaments in tufts along the edge. Such tufts often appear as in Fig. 2, but the filaments may grow to be six inches long. The highest temperature of the water in which this growth has been so far reported is 85° C., life conditions which must, indeed, be considered remarkable.

Examined under the microscope, the filaments present some curious features. Under the low powers one sees an apparently homogeneous strand of a gelatinous consistency, shown in Fig. 3, that is coated

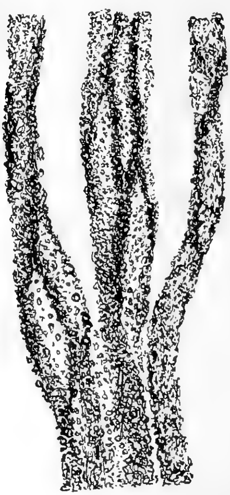

Fig. 3.

all over with small crystals. It is easy to prove that this deposit is sulphur, since the granules can be dissolved away in carbon bi-sulphide, leaving only the gelatinous filament quite soft and flaccid, where it was formerly somewhat stiff and stringy. One sees no further indication of organization until the filament is examined under an immersion lens with, perhaps, a magnification of 1,000 diameters. Even then, to obtain the best results, the specimens must be stained. Such preparations then reveal a remarkable structure. The filament is made up of innumerable bacteria imbedded in a gelatinous matrix. They are chiefly rod-like forms and are arranged in lines and chains. The individual rods vary greatly in length, but it is quite plain that the smaller forms result from the division of the larger. Fig. 4–a illustrates the characteristic form and arrangement of these bacteria under very high magnification, about 2,000 diameters. The long axis of the rods are usually parallel with the general direction of the filament, the width of which is made up of many hundreds of the organisms placed side by side. The filament is really an elongated zoogloea, or colony of bacteria, all coated over with sulphur grains.

It is a difficult matter to determine exactly what form of the bacteria this is. One should know whether the sulphur grains are deposited by the activity of the organism or not. Presumably this is so, and the type is a species of *Beggiatoa*, a genus of bacteria characterized by its peculiar habit of depositing sulphur from water containing sulphuretted hydrogen in solution. But the genus *Beggiatoa* is remarkable because it includes some of the largest species of bacteria known, and the cells are of such a size that many sulphur grains may be contained in their interior. There are without question species of *Beggiatoa* in the hot springs of the Park, and it may be just as well to compare one of these forms shown in Fig. 4–b, under magnification of 500 diameters, with the organism under consideration. It will be seen that the cells of the *Beggiatoa* filament are very large in comparison with those of Fig. 4–a, although the magnification of the latter is about 2,000 diameters. The dark dots in the interior

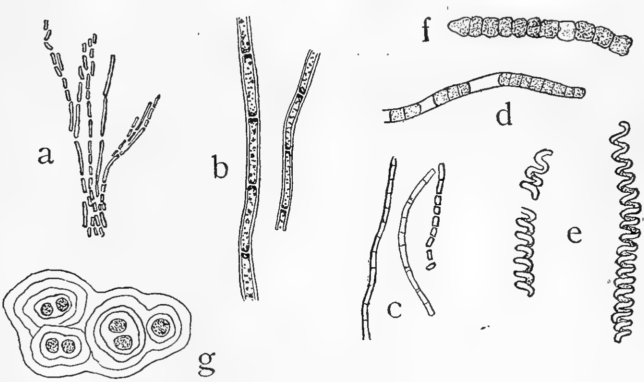

Fig. 4.

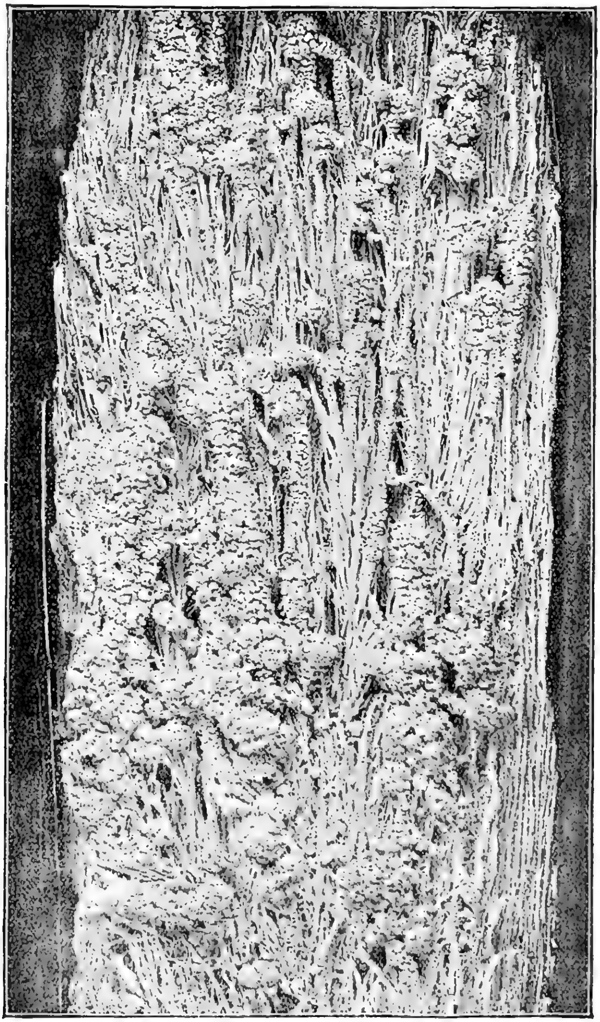

FIG. 5.—A Piece of Travertine.

of the cells are sulphur granules. If our plant is not *Beggiatoa* it would be classified as a *Bacillus* because of the rod-like character of the cells. The writer will not attempt to name it on the insufficient data, and it serves as an excellent illustration of the difficulties with which one contends in attempting to define precisely the relations of these organisms to one another. It is a very interesting form from its habits and its habitat, and probably the most adventurous organism in the hot springs.

This peculiar species of the bacteria leaves a record of itself in the mineral deposits in the following manner. The filaments, at first delicate and exceedingly flexible, become coated with such a thick deposit of sulphur and calcium carbonate that they lie as stiff fibers along the edges of the hot pools and upon the bottom of the streams. Sometimes the collections of these filaments have the appearance of frost work in the scalding hot water. Eventually the threads become cemented together by the continual deposition of lime, but they impress their individuality upon the resulting formation by giving it a fibrous structure. These points are well illustrated by the photograph of a piece of formation shown in Fig. 5.

The tufts of waxy bacterial filaments are often associated with extensive growths of quite a different character. Large areas upon the sides and bottoms of the pools and streams are frequently covered by a closely packed felt of extremely delicate filaments. The surface is smooth and slippery, and it feels like a sheet of rather stiff jelly all gritty because of the numerous crystals of calcium carbonate deposited in the substance. Under magnification the true structure is made apparent, and one sees here a closely woven mass of very minute filaments agglutinated together. The individual filaments are sometimes less than one-thousandth of a millimeter in diameter, so that they look like mere lines even under a magnification of 200 to 300 diameters. Fig. 6 illustrates the general appearance of

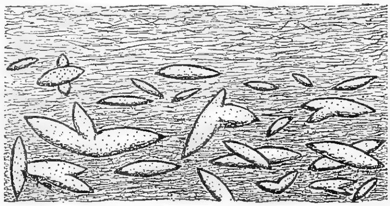

FIG. 6.

the leathery felt and shows the many crystals of calcium carbonate imbedded in the mass of filaments. The cells of this plant are several times longer than broad and the color is greenish. The genus is called *Phormidium* and contains forms closely related to a very common blue-green alga of stagnant waters, named *Oscillatoria*. There are several species of *Phormidium* in the hot springs, differing from one another chiefly in the measurement of the cells. The smallest forms, such as are shown in Fig. 4–c, are found in water as hot as 75° C., while the larger types (Fig. 4–d) only inhabit water that is several degrees cooler. The color of the *Phormidium* growths is quite variable. When actively vegetative the tint is bright green, but older sheets become brownish and the presence of various mineral deposits give the growths shades of golden yellow and dark red. If dried in the sun the colors fade out through various tints of yellow and pink to the everlasting white of the formation.

Another interesting plant frequently makes itself prominent, side by side, with the *Phormidium*. It is called *Spirulina* and, as the name suggests and the figures (Fig. 4–e) show, the form is a filament closely coiled in a spiral. This organism has the power of forward movement, the free ends swinging from side to side in such a man-

ner that the delicate thread travels over its substratum and among other algæ. *Spirulina* mixed with *Phormidium* often forms curious raised rims about the pools of hot water. This phenomenon is especially well shown upon the edge of the Prismatic Spring in the Middle Geyser Basin, also known under the more picturesque name of Hell's Half Acre. The Prismatic Spring is an immense pool of hot water about a hundred yards wide. The center of the spring is of a dark blue color, which gradually changes through shades of green to a light yellow around the margin, where the water is shallow over the sloping bottom of the basin. On the edge of the pool is a greenish growth variegated with brown and yellow. It has the form of a rim several inches wide raised above the mineral substratum and acting as a slight obstruction to the ripples of hot water that constantly splash over it upon the formation. The substance of the growth is rather firm like wet felt, and the surface, figured with raised lines, resembles tripe. The masses of wet algæ are so warm that one cannot hold them, and the water that laps the edges of the deposit is much too hot to approach with safety. It is in situations such as these that the algæ of thermal springs play an important part in moulding the form of the mineral deposits, but this is a subject that will engage our attention later on in the paper.

We have now considered the organisms that are most characteristic of the hot water of the thermal springs. It is altogether probable that careful studies on the spot would bring out many interesting facts in respect to the number of species, and the precise range of their distribution through the various springs in relation to the temperature and character of the water. It is an interesting field for study, and deserves the attention of a botanist for three months, instead of three days, which the writer once spent in the Geyser Basin.

As the water grows cooler in the overflow streams the conditions gradually become suitable for types more familiar to the botanist. A species of *Anabæna* (Fig. 4–f) is prominent in some places, and members of the Chlorophyceæ and diatoms are found, but these types are not truly a part of the flora of the thermal springs.

One more form deserves notice from the peculiarity of its structure and the curious situations in which it is found. There are places in the Geyser Basins and on the deposits of Mammoth Hot Springs where steam issues from the cracks and crevices of the formation. One may frequently find the mineral matter in these openings colored a bright green by a delicate film of slime. This is largely made up of *Glœocapsa* (Fig. 4–g), a unicellular alga that is characterized by the presence of very thick cell walls made up of concentric layers, the outer becoming gelatinous. These slimy films must be kept continually damp by the hot steam that issues from the vents.

The inhabitants of the thermal springs are all members of one or two families of plants, and a greater interest attaches to them because the fact is plain that the conditions under which they live are not suitable for the forms of algæ that commonly crowd our ponds and streams. In a general way they are all closely related to one another. The colored forms are all members of the class Cyanophyceæ, the lowest group of the algæ, and the colorless type all belong to the class Schizomycetes, or bacteria, the lowest group of the fungi. Moreover, the forms of Cyanophyceæ and Schizomycetes are quite generally considered to be near relatives. Indeed, all the members of both groups have been classified under one name by some authors and called Schizophytes, which means plants that split. All the forms agree in having a very simple

cell structure. Until quite recently investigators have been unable to find any indication of that organization of the protoplasm into a nucleus and chromatophore, such as is present in the ordinary plant cell. Now botanists are able to distinguish nuclear matter in the cells of some of the larger types, but it is found in a scattered form with vague contours and never in the shape of a well-defined, compact structure. The phenomenon of cell division is here found in its simplest type and gives the name to this group of plants. The cell simply splits apart and there are two individuals where formerly there was one. The cells may remain attached to one another and so form filaments of considerable length, but each cell is probably physiologically quite independent of its neighbors. The facts plainly indicate that the protoplasm of these types is not as highly organized as that of more complex forms of plants; probably they are able to withstand these unusually high temperatures because of this low grade of protoplasmic organization. Perhaps, but this does not necessarily follow, these organisms resemble more closely the primitive first forms of life than any other living types. One would like to know about the precise conditions governing the lives of these simple cells and something of their past history. It is possible that they may have crept into the hot springs from the colder water, or perhaps their ancestors may have always lived under the infernal conditions which now surround them. A very thorough study of various pools and streams at different temperatures might solve the problem. The field of study is as interesting as it is difficult.

Now let us examine these organisms in their rôle as geological agents or factors influencing the deposition and shape of the formation. We must remember that the formations are of two sorts: first, the calcium carbonate deposits illustrated most strikingly by the immense pile at Mammoth Hot Springs; and second, the silicious formations of the geyser basins. Calcium carbonate ($CaCO_3$), the substance which makes up the chief part of all limestone and marble, of coral and most shells, is practically insoluble in pure water. However, water charged with carbon dioxide (CO_2) dissolves calcium carbonate, and it is pretty generally believed that the latter passes over to a new substance, calcium bi-carbonate with the formula $Ca\,(HCO_3)_2$. But calcium bi-carbonate is not known in a solid crystalline form because, when water containing it in solution is allowed to stand exposed, the carbon dioxide escapes and the usual calcium carbonate immediately separates out from the solution.

The water that issues from the formation on the terraces of Mammoth Hot Springs has been under pressure and is highly charged with carbon di-oxide. It holds an unusually large amount of calcium carbonate in solution, a fact for which the bed of Mesozoic limestone, through which the boiling hot water passes on its way to the surface, is responsible. When the water emerges from the orifices of the hot springs and spreads out in the shallow streams and pools there is an immediate escape of carbon di-oxide from the supersaturated solution. The insoluble calcium carbonate is then thrown down as the dazzling white deposits of travertine. One may see the results of this property of the hot water illustrated by the absurd incrusted baskets, pine cones and horseshoes that are on sale at the hotels. This phenomenon is, of course, in no way connected with the activity of the organisms, and there is no question but that travertine would form and terraces would be built up even if no plant life were present in the water.

But the plant life undoubtedly hastens the deposition of calcium carbonate in the

following manner. The green plants require carbon di-oxide for the processes of assimilation and they take it from the water, which means, in this case, the deposition of a certain amount of calcium carbonate. There are many plants that have the power of taking calcium carbonate from water. *Chara*, the stone-wort, the marine algæ called Corallines, forms of the group Siphoneæ inhabiting the coral sands of Burmuda and Florida, are examples, and besides these there are species of Cyanophyceæ closely related to the forms actually found in these hot springs. If the tufts and felts be teased out, one may find innumerable crystals of calcium carbonate, varying in size, held in the meshes of the filaments. We have tried to show the appearance of such a preparation in Fig. 6. One may observe this very significant fact that the crystals at the bottoms of the tufts and sheets of algæ are large, and there are places where they have become cemented together into flakes of mineral deposits. In the middle region and towards the surface of the felts the crystals are small and scattered. It is evident that these expanses of algal growth lay down sheets of calcium carbonate and that the tufts build up little mounds upon the generally smooth surface.

It is altogether probable that the mineral deposits follow the development of the algæ very closely and actually entomb the older filaments at the bottom of the growths in limestone crypts. It is interesting to know that the first travertine thrown down in these waters is probably associated with the vegetation at the time of the deposit. We say probably because the fact cannot be proved in these hot springs, but we can reason from analogy, for the conditions here are quite similar to those of the waters of Carlsbad, in Germany. There the springs issue from granite rocks and the travertine is not deposited until traces of vegetation appear in the water. These interesting observations were made by Ferdinand Cohn. As all the streams of Mammoth Hot Springs issue from travertine deposits, it is impossible to tell exactly where the deposition first begins.

However important these algæ may be in their rôle as rock-formers, a greater interest attaches to them because most of the beautiful sculpturing and coloring of Mammoth Hot Springs is directly due to their presence. The rims on the pulpit basins (see Fig. 7) are covered with a growth of algæ. The interiors of the basins are lined with sheets of green and yellow on a white background, but it is the outside of the basins that exhibits the most beauty. There are pillars and flutings and stalactite-like structures all colored brown and orange and green. The algæ are responsible for almost all these peculiarities. If they were not present the water would flow in shallow sheets and fresh deposits of calcium carbonate would be laid down like so many coats of whitewash with unrelieved monotony.

But the algæ change the conditions. Here they grow in ropey welts down the sides of the pulpits from the lips of the basins; there they have formed a raised rim upon some flat surface and partially dam up some small pool or stream of water. Here they hang down from some projecting ridge as a slight fringe that drips water. Everywhere the growth of vegetation is but a thin veneer over a skeleton of mineral deposits that follows closely the lines of the algal sheet. The filaments project from a granular and gritty deposit enveloping the fibers that are not so fortunate as to be at the immediate surface. Consequently when, for some reason, the water ceases to flow over a certain part of the formation, and the colored vegetation dries up and entirely fades out in the fierce glare

of the sun, there is still left the form of the growth in raised relief upon the travertine.

In the shallow pools, only a few inches deep, one may find the most delicate frost-work creeping in from the side. Here the algal network is a skeleton upon which is laid a coating of calcium carbonate in the form of delicate granules. The filaments frequently have a beaded appearance, somewhat similar to cobwebs covered with minute drops of dew. The effects are particularly striking when a stream of water suddenly spreads out over a flat surface. Then the frosted growths radiate out from a common point and the effect is sufficiently prominent to give rise to the term 'fan' that is applied to such figures. Of course, the more delicate patterns upon the formation are not lasting. The wear and tear of the summer tourist season, and the freeze-up in the winter, break the lace work, but it is quickly renewed every spring. Indeed, there is opportunity for the exhibition of taste in the judicious distribution of the hot streams over the older portions of the formation. They could readily be kept in repair, for fresh deposits are laid down with astonishing rapidity.

We now pass to the consideration of the silicious formations of the geyser basin and here we encounter some peculiar problems. The water comes forth boiling hot and supersaturated with silicious matter. There is no question but what some of this must be thrown down from the solution as the water cools. Indeed, one may sometimes find soft deposits of a gelatinous nature around the vents of various springs and geysers, apparently thrown out by a sudden discharge. Evaporation alone would make possible the gradual building-up of the interesting cones around the orifices of geysers. However, the deposition as a rule must go on very slowly, and the calculation has been made that in certain instances not more than one-sixteenth of an inch is deposited each year.

But our problems are concerned with the beautiful transparent pools scattered over the formation. Their water is as clear as crystal and the mineral matter on the sloping sides is as firm and hard as chalcedony. There is no vegetation in the hottest of these pools, but where the water has cooled down a few degrees one may find abundant growths of algæ. There are membranous patches of various shades of green and masses of yellowish jelly and also tufts of very delicate filaments that hold many bubbles of gas entangled in their meshes, making them rise up like small balloons held down by numerous cords. There are many peculiarities about these pools that make them very interesting. The sides are frequently moulded into curious figures, giving reasons for such names as 'The Oak-leaf Spring,' 'The Aquarium,' etc.

But the most peculiar structures are pillars that stand up from the bottom of the basin. They are of various sizes, some merely slight cones that roughen the stony floor of the pools, others finger-like projections. In its fully developed state the column rises to the surface of the water. As it grows older it becomes gradually thicker until the mass of deposit resembles a small island in a miniature sea of hot water. Fig. 7 shows one of these shallow pools from which the water had been drained. There are many columns, large and small, present in this instance, and the figure illustrates a characteristic peculiarity, namely: that often the top of a pillar spreads out at the surface of the water in a form that resembles the umbrella-like top of a toadstool.

How are these columns and the figures in raised relief formed? Have they any connection with the algal vegetation? Indirectly there is a very important relation. It is not probable that these algæ secrete

silica. There are comparatively few plants that have this power and among the algæ the forms called diatoms are the only examples. They are not found in these hot pools. The writer has never heard that any member of the Cyanophyceæ has this power, and the specimens that he has examined from the hot springs gave no evidence that silicious matter was secreted directly around the fibers, for the deposits were in the form of granules of amorphous silica distributed among the filaments. It is a principle well known to the physicist that matter in solution is often far more likely to be thrown down when foreign bodies are in the fluid. The mere presence of such material offers surface or otherwise disturbs the equilibrium and hastens the appropriate physical changes. Thus the phenomenon of crystallization will take place much more quickly and completely from a solution if there be strings or other

FIG. 7.

bodies present upon which the crystals may form.

It seems probable that in these facts we have an explanation of the influence which vegetation appears to have upon the deposit of silicious material in the pools of the geyser basins. The mere presence of the algal filaments as foreign bodies encourages the deposition of silica, and it naturally follows that the greatest amount of silica is thrown down where the vegetation is thickest. This gives us the entire secret of the peculiarities of columns and mouldings. As has been before described, it is the habit of algæ in quiet water to grow up in tufts. A tuft once established leads to the deposition of more silica at that particular spot, and soon there will be formed a little mound or cone, capped and covered by a mass of filament. The algal filaments always tend to grow upward in quiet water, if for no other reason because of the numerous bubbles of oxygen thrown off, which, becoming entangled in the threads, tend to buoy them up. As the algal cap on top of a cone grows upward, more silica is laid down at its base, and so a column of deposit gradually rises. When the cap of vegetation reaches the surface of the water, there is, after the habit of such forms, an immediate radiation of the filaments in all directions. Consequently, when the final deposit of silica is left upon the top of the column, it extends on all sides as an overhanging capital. As the shaft of the pillar is covered with the sheet of vegetation, we can readily understand why it should thicken and why there might be irregular protuberances or even smaller columns rising at different levels along the sides of the larger. Of course, the algal growth will not be uniform on all sides of the pillars, any spot that is especially vigorous leaving a record for itself through a larger amount of mineral deposit.

Much more must be known about the exact conditions of growth in these thermal waters, before the many peculiarities of the mineral deposits are explained. But a new interest is added to the hot springs of Yellowstone Park and their deposits when one thinks of the parts these simple organisms play in the construction.

Children of steam and scalded rock, a story you have to tell,
Writ in the glare of sunshine bright,
Sculptured and etched in marble white,
Illuminated in colors bold,
Richer than ever parchment old,
Children of steam and scalded rock, what is the story you have to tell?

Our legends are old, of greater age than the mountains round about.
We have kept our secrets epochs long,
They are not to be read by the passing throng.
It is nothing to us what men may say.
If they wish our story the price they must pay
In hard brain work, ere the tales are told. We challenge mankind to draw them out.

Children of steam and scalded rock, your challenge must rest for the present age.
I have scarcely broken the outer crust
That covers the greater truth, but I trust
Some man will follow and therein find
Knowledge, that to the Present shall bind
The Past with cords wherein entwine
Threads of the perfect truth, divine.
Children of steam and scalded rock, some man to come will accept thy gage.

BRADLEY MOORE DAVIS.
UNIVERSITY OF CHICAGO.

RAREFIED AND CONDENSED AIR.

AFTER reading Paul Guessfeldt's enthusiastic description of 'mountain-ecstasy,' as he calls it, which the rarefied air of high altitudes produces and which he describes as consisting of 'an increased sense of joy caused by an increased muscular activity, and a wonderful buoyancy of the feelings which at moments rises to ecstasy,' we are tempted to follow him to those heights in order to experience these feelings which can be so easily obtained with a little physical exertion.

A different point of view is presented to us by D'Orbigny (1826) in an account of the sensations he experienced while crossing the highest pass of the Cordillera in Bolivia, which is 4,500 meters (about 15,600 ft.) high, on his way from the coast of Peru to La Paz. For several days before reaching the highest part respiration was difficult. His driver, the mule he was riding and his dog suffered so much that they were compelled to halt every 20 or 30 meters to regain their breath. While crossing the crest of the ridge he suffered intensely from pains in the temples, vertigo, and extreme difficulty in breathing. Every movement of the body produced palpitation of the heart, followed by a feeling of general debility, until bleeding of the nose finally relieved him. During this attack of 'mountain-sickness' he saw two natives, who had overtaken him, hurry on their way, climbing the rocks with the greatest ease.

It is evident that D'Orbigny did not belong to an Alpine club, and did not have the necessary training, or else he would not have suffered so intensely at an altitude which has no effect upon those who now ascend Mount Blanc.

A man who has had no practice in mountain climbing is apt to experience sensations similar to those which D'Orbigny described, while yet under the ordinary atmospheric pressure. For instance, in hurrying up a steep incline, say in the winter, when you sink into the snow with every step, you will very likely become short of breath, since the rapid climb prevents the full expansion of the lungs. This disturbs the circulation of the blood, which, being no longer freely admitted into the contracted lungs, collects in the veins. They swell up, the face becomes purple, the pulse-beats are accelerated, and palpitation of the heart sets in. In case the exertion is continued, an attack of nausea is imminent, together with a feeling of faintness in the lower limbs, as the overworked muscles are deprived of their requisite supply of oxygen. A few long drawn breaths usually suffice to remedy the disorder. By gradually becoming accustomed to walking and breathing slowly and regularly a further attack is prevented.

These symptoms, as they manifest themselves in the rarefied air of high altitudes, constitute what is known as mountain-sickness, and persons unaccustomed to mountain-climbing are frequently affected by it even while resting or when not exerting themselves. Here, again, the cause of the disorder is the insufficient expansion of the lungs, caused by the diminished atmospheric pressure which renders respiration difficult.

But, it may be objected that the energy with which we inhale the air is the same at high altitudes as below, and the rarefied air ought to penetrate into the lungs more easily. This is perhaps true, but, although we expand the chest during inhalation, the expansion of the lungs is only accomplished by means of the atmospheric pressure. The lungs are not attached to the inner surfaces of the thorax and can move freely. A wound in the thorax which admits the passage of air causes the lungs to contract, and all the exertions of the breathing apparatus will be powerless toward relieving this contraction.

As long, however, as the cavity of the chest remains closed and contains no air, the pressure of the air in the lungs acts from within outwardly and by expanding the lungs will cause them to remain in contact with the sides of the chest as it expands during the process of inhalation. The ease with which the lungs are expanded depends upon the amount of atmospheric pressure which is brought to bear upon their elastic power of resistance, and this action consequently becomes more difficult as the lighter pressure of higher altitudes is reached. Let

us suppose that the usual pressure is reduced to one-half, then the rapidity with which the lungs are expanded, although still greater than the usual rate of the chest expansion, is yet only half as rapid as when under the customary atmospheric pressure, and under certain circumstances this may seriously disturb inhalation.

Exhalation, on the contrary, is accelerated by the lighter pressure of a rarefied atmosphere. It generally takes place without the aid of the muscles which assist in the process of inhalation. The expanded parts, as the lungs, diaphragm, etc., contract to their original size and position by reason of their elasticity, as soon as the muscular force which was applied during inhalation is relaxed. The employment of the abdominal and intercostal muscles as an aid to exhalation is exceptional.

The only obstacle which retards the contraction of the lungs is the pressure of the outer air, which resists the outflow of the air from the windpipe and is diminished as the atmosphere becomes rarefied. Consequently the contraction of the lungs is greater and more rapid in a rarefied atmosphere. Exhalation is, therefore, in general, a mechanical process, and as such is subject to a certain law acording to which it can be performed on the summit of Mount Blanc in $\frac{8}{10}$ of the time required under the ordinary atmospheric pressure.

Humboldt tells us that newcomers in the vicinity of Quito, Ecuador, where the altitude is between 2,600 and 3,600 meters (11,800 ft.), have considerable difficulty in breathing, especially when talking rapidly. This is explained by the fact that the supply of breath usually reserved for the formation of sound escapes more rapidly and is therefore sooner expended. It has also been observed that some persons are unable to whistle where the pressure has only been diminished from 760 mm. (ordinary atmospheric pressure) to 500 mm. The whistling sound is produced by placing the lips in a certain position, and depends upon the rapidity with which the air is forced out of the lungs by means of the abdominal muscles. Naturally, the amount of muscular force so expended is still suited to the requirements of the denser air to which one has been accustomed. As the atmospheric pressure is diminished, the air escapes more rapidly and the expected sound is not formed. In order to learn again how to whistle, it is necessary to place the lips in another position and to apply the muscular force differently, which always requires considerable time and practice.

Physicians who have made a short stay at Davos, which lies at an altitude of only 1,600 meters (5,200 feet), state that during that time their respiration was much accelerated, while there was an inability to breathe deeply. The explanation of this phenomenon is the diminished atmospheric pressure which also causes an acceleration of the pulse-beats—the inevitable result of insufficient lung-expansion. Accelerated breathing at high altitudes affects metabolism by aiding in the removal of gaseous excretions, such as carbon dioxide.

Aëronauts observed the acceleration of the pulse to be the first physiological change. They can reach a much higher altitude than mountain climbers without having any difficulty in sustaining respiration, as their muscular exertion is not so great. But the transition to the rarefied air is more sudden, and the increased, difficulty in breathing, which now appears although the aëronaut is generally unconscious of it at first, results from an insufficient expansion of the respiratory organs, which renders them incapable of admitting the requisite amount of rarefied oxygen The strength of his respiratory muscles is diminished; he finally loses control of his limbs, and his senses are dulled. This

was the experience of Eroce Spinelli, Sivel and Tissandier, who, on August 15, 1875, reached an altitude of 7,000 m. (23,750 ft.) with an atmospheric pressure of only 300 mm. in two hours. They followed Paul Bert's advice and inhaled oxygenated air, as a result of which their strength immediately revived.

After a longer sojourn in regions of high altitude the symptoms of mountain-sickness pass away, as respiration is gradually regulated to suit the conditions of the rarefied atmosphere. The change which this necessitates is easily explained. In order to breathe deeply it is necessary to expand the lungs more slowly, and this is only accomplished by means of continuous unconscious practice which strengthens the respiratory muscles. The members of Alpine clubs who make high ascents keep in practice by repeating their excursions frequently. Hence they are far less subject to mountain-sickness than those who have had no previous training.

The wonderful feats of Paul Guessfeldt, which are described in the German Rundschau of 1892, are a good illustration of the benefits to be derived from such a training. He breathed and moved without any inconvenience at an altitude of about 5,500 meters, where the atmospheric pressure is equal to only one-half of the ordinary pressure. In ascending Mt. Aconcagua, in Chile, he had no difficulty in breathing until after the altitude of 6,000 meters had been reached, and even then he was finally able to ascend to the summit, which has an elevation of nearly 7,000 meters, or 23,910 ft., an altitude at which aëronauts are compelled to have recourse to their supply of oxygenated air.

A distinguishing characteristic of the air of high altitudes as compared with that of lower regions is its freedom from moisture. The atmosphere is so dry on the plateaus of the Andes in Peru and Bolivia, where the altitude ranges from 3,600 to 3,900 meters, that the flesh of butchered cattle can be dried in the open air. The two explorers, D'Orbigny and Wedell, both report that the sheep which are killed there are split open and salted, after which they are hung up in the open air, and are dried in four or six days.

The ocean is the chief source of the moisture contained in the atmosphere; consequently the interior of the continents is drier than the coast regions; and in the same way the moisture decreases as we rise above sea level. The lower stratum of air up to about 2,000 meters (6,500 ft.) contains one-half of the whole amount of aqueous vapor in the atmosphere, and here the cloud-formations are densest and most frequent, while above this altitude the sky is much clearer.

It is a well-known fact that extreme dryness of the atmosphere stimulates the nervous system, making one feel brighter and more inclined for both physical and mental activity. The inhabitants of very dry regions, according to the reports of explorers, are free from any tendency to obesity.

In trying to escape from the hot air of the cities in the summer we look for a place which is situated higher above sea level, because we know it to be cooler. In the torrid zone, resorts with an elevation of from 2,000 to 3,000 m. are popular. In spite of being nearer to the sun, the air is cooler, as the sun's rays have practically no effect upon it. The air allows the rays to pass through it freely, but receives its warmth from the dark heat rays which are reflected from the earth after the sun has warmed it. The lower strata of air are, therefore, always warmer than the upper. But the plateaus of the highlands are cooler too, as well as the summits and crests, for their rarefied atmosphere is incapable of absorbing as much of the heat reflected by the earth as the denser atmosphere of the

lowlands. Although the surface of the earth receives more heat at high elevations, it is immediately reflected back into space without heating the air to a corresponding degree. This is evidenced by the fact that at high altitudes the difference of the temperature in the sun and in the shade is greater than in the lowlands. But the effect of the sun's rays is felt more keenly at a high elevation, so much so that persons staying at Davos can enjoy a sun-bath in a sheltered spot even in the cold of winter, although wearing much thinner clothing than at home.

It takes a visitor at Cerro de Pasco, in Peru, which lies at an elevation of 4,500 meters, ten or twelve days to thoroughly regulate his respiration to the conditions of the atmosphere. In case his suffering is greater at first, it often happens that he is compelled to make a temporary change of residence to a point some 1,000 meters nearer the level of the sea. Even during the descent he begins to breathe more easily and feels brighter and stronger.

The inhalation of air which has been artificially condensed, as in a pneumatic cabinet, produces quite similar sensations. An asthmatic patient placed in an atmosphere where the pressure has been augmented by nearly one-half will immediately be enabled to breathe more freely; respiration becomes slower; his excited nerves are quieted, and he feels imbued with renewed vigor.

The mechanical action of condensed air as it affects respiration is the reverse of the action which takes place in rarefied air. A higher atmospheric pressure facilitates the expansion of the lungs, and the condensed atmosphere, by delaying the egress of the air expelled during exhalation, finally effectuates a distended condition of the lungs. The pulse-beats become slower at the same time, and the veins, which were surcharged with blood under a diminished pressure, are now emptied more thoroughly. This is the cause of the decrease of congestive conditions in a pneumatic cabinet. The amount of oxygen which we inhale is increased in proportion to the increased condensation of the atmosphere, thereby enriching the blood. If the treatment is continued, this soon makes itself manifest by an increased appetite and a healthier complexion. The invalid gains in strength and vitality. Respiration is facilitated even outside of the cabinet, and by such observations we perceive that the employment of condensed air has after-effects, which supposition the spirometer confirms. A deeper and more quiet respiration has been observed in some cases after the elapse of one and even two years.

The air which is admitted into the pneumatic cabinets by means of air pumps can be kept at any degree of condensation. The cabinets, which are of various sizes, are arranged to admit from three to fourteen persons, and naturally great care is taken to have a good ventilation. They generally stand in the center of a lighted hall; their walls are composed of sheet iron and provided with windows which admit ample light for reading. The cabinets are used exclusively for the cure of catarrhal diseases, to facilitate the respiration of asthmatic patients, and to improve the condition of the blood of anæmic persons, in which cases the condensed air frequently proves beneficial after all other remedies have failed.

The first pneumatic cabinet was established somewhere in the thirties, at Montpellier, by a physicist named Tabarie, who later gave the management of it into the hands of a physician. Pravaz soon followed his example at Lyons, and the reports of the two scientists as to their observations made on healthy and diseased persons were presented before the French Academy and to the medical world in quick succession.

About thirty years later the idea of putting condensed air to this use spread from France to other countries of Europe, and the largest institution of this kind at present is at Reichenhall, the property of E. Mack, in which 53 persons can make use of the heightened pressure at the same time.

In 1841 M. Triger, a civil engineer, introduced in France the idea of using a heightened atmospheric pressure in building sub-aqueous works, and this gave an opportunity to observe what effect an atmospheric pressure which was much higher than that of a pneumatic cabinet would have upon the workmen. The work under pressure is carried on in an iron shaft, the sides and top of which are air-tight. It is sunk to the bottom, like a diving-bell, while the upper end protrudes above the surface of the water. The fresh air which is continuously pumped in from above expels the water below, leaving the bottom free to be worked upon. The shaft sinks deeper and deeper as the earth is removed, until there may be a pressure of $3\frac{1}{2}$ or nearly 4 atmospheres. A pressure of ten meters of water is equal to about one atmospheric pressure.

The effect of the condensed air upon the laborers was found to be surprisingly favorable up to a pressure of two atmospheres. The hard work was accomplished more easily and with less fatigue than in the open air, and in such exertions as running up a ladder they did not get out of breath. Even after working hours the men felt stronger and in better spirits.

But when the pressure exceeds that of two atmospheres the men begin to have certain unpleasant sensations, such as itching and pains and swelling of those muscles which are strained the most. These symptoms do not, however, appear while under the heightened pressure, but make themselves felt during the time that the men are under the normal pressure, and pass away again as they return to their work. The overseers are exempt from these effects. They receive instead a mental stimulus which is manifested by an increased impulse to talk.

If the atmospheric pressure is still further increased, the resistance against exhalation becomes stronger. The action of the respiratory apparatus is weakened by the increased distension of the lungs until it finally becomes almost imperceptible; speech is difficult, and whistling impossible. The result of the too rapid contraction of the lungs under a diminished pressure which prevents whistling is the same as that which follows when the egress of the air expelled by the lungs is delayed.

The enlivening influence on the workmen is diminished as soon as the pressure exceeds that of three atmospheres. The slow and imperfect performance of the respiratory function begins to have a detrimental effect upon the gaseous interchange which takes place in the lungs by causing the carbon dioxide to be retained in the blood. The laborers become more easily fatigued, and a decrease of appetite is followed by loss of flesh, if they continue the work. We find, therefore, that there is a limit to the condensation of air which a man cannot overstep without detriment to himself, but there is a wider limit in this direction than in that of rarefied air.

Experience proves that a temporary change from the normal pressure to an increased or diminished pressure is pleasant and also benefits vitality in various ways. We are able to ascend to any altitude at which the air is rarefied to the desired degree, but the privilege of choosing a denser atmosphere in which to live is denied us. It is only from a few places at very high elevations that convalescents can be sent down to a lower altitude where they quickly recover by inhaling air which is more condensed and contains a larger proportion of oxygen. The inhabitants of the

lowlands are confined to the pneumatic cabinet in their search for these benefits. From what has been said regarding the mechanical change which respiration undergoes we gather that a temporary employment of condensed air, besides its various other effects, would be a good preparation for the proper performance of the respiratory function in a more rarefied atmosphere.*

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* Translated from the author's MS. by Henriette Weber, Columbus, O.

NOTES ON THE NATURAL HISTORY OF THE WILMINGTON REGION.

A BRIEF collecting trip to the vicinity of Wilmington, N. C., made about the middle of April, greatly impressed me with the natural history advantages of the region. I publish these few notes in the hope that they may be of service to other naturalists who think of visiting the Southern coast.

In Wilmington itself no one can fail to notice the admirable shade tree, the laurel oak (*Quercus laurifolia* Michx.), so common along the streets. This tree in Wilmington passes under the name of water oak; in South Carolina it is known as the Darlington oak. Its straight bole, symmetrical top and moderate size give it an elegance of shape well suited to city streets, and the impression of finish is heightened by the glossy aspect of the foliage.

From the city there runs a most excellent road, eight miles long, to Wrightsville, a settlement on the coast. The road is a well-kept shell road, smooth, hard, and good for bicycling. Scrub oaks, elms, long-leaf pines and cypresses edge it, and near the sound the full green heads of the live oaks are seen on all sides. In the open meadow-like places (savannahs) to the right and left of the road there grow in great abundance insectivorous plants, the most interesting members, to the general biologist at least, of that rich Wilmington flora made known through the labors of Curtis, Wood and other systematic botanists. The yellow-flowered pitcher plant, *Sarracenia flava*, dots the savannahs in all directions; its great flower (four inches wide) upheld by a scape one to two feet, making it a conspicuous object. The fly-trap, *Dionæa*, and sun-dew, *Drosera*, neither in flower at the time of my visit, are scattered thickly about. Intermingled with these are a blue and yellow species of butterwort, *Pinguicula*, their bright flowers standing out clearly against the (at this time) brownish savannah and often leading one to patches of *Dionæa* and *Drosera*, which otherwise would have been passed by unnoticed. These five insectivorous plants may sometimes be found growing together in a little patch of ground, scarcely larger than a square foot.

The topography of the Wrightsville district is that characteristic of the Carolina coast, and in a less degree of the Southern coast in general. A sound separates the mainland from a seaward strip of land, known as the 'banks.' Wrightsville, largely made up of houses occupied only during the summer, is on the mainland. Opposite it, on the banks, is a newer summer settlement. Between the two, the sound is crossed by a railroad trestle, the piles of which afford good collecting.

The sound something less than two miles wide, is divided into a narrow outer portion, adjoining the banks and known as the banks channel, and a wider inner portion, studded with sandy-mud shoals. The banks channel is a narrow but pretty boating ground, opening out to sea through two inlets, one recently made in a heavy storm. Along the inner edge of the channel lie some islands, the 'hammocks,' wooded with live oaks, about which jackdaws (*Quiscalus major*) were flying. This bird is said to spend the winter here.

At high water one can sail over many of the shoals of the inner part of the sound, but at low water the course from the mainland to the banks channel is a meandering one. The shoals are alive with worms, *Arenicola*, *Diopatra*, *Clymenella* and other annelids, along with the great *Balanoglossus*, were dug up in quick succession. The reddish egg masses of *Arenicola* lay about in abundance on the flats. The low water collecting in the shoal part of the sound is very easy. Pushing along in a skiff through the shallow channels between the flats, one finds starfish (*Asterias*), the red and white sea-urchins (*Arbacia* and *Toxopneustes*), abundant crabs and other common bottom forms. Scattered about over the bottom in great numbers is the interesting anemone, *Cerianthus americanus*. The tubes that were dug up were something over a foot in length; they contained animals, which of course had greatly contracted, about six inches long. This distinctively Southern actinia, originally found on the South Carolina coast by Professor Louis Agassiz (Verrill, Revision of the Polypi of E. Coast of U. S., p. 32. Mem. Boston Soc. Nat. Hist., Vol. I.), has been observed by Mr. Wm. Stimpson and Professor McMurrich at Beaufort, N. C., where I have seen it myself. It is, however, far more abundant at Wrightsville, and any one wishing to work out the life-history of this remarkable form could find no better locality than the latter place. I may add that the reproductive organs of the specimens I collected were very small. The breeding season probably comes on later.

Just before high water I towed in the neighborhood of the old inlet. As I had anticipated from previous experiences in Beaufort harbor at this time of year, not much of interest was in the water. Small hydromedusæ, crustacean larvæ, abundant *Sagittas*, make up the tow stuff. Later in the year, doubtless as at Beaufort, the towing is excellent. I am told that abundant large jelly-fish and Portuguese men-of-war make their appearance in August and September.

The sea-beach has a very gentle slope, and judging in part from specimens sent me by Mr. Chas. M. Whitlock, of Wilmington, many things of interest are to be had just beyond the line of breakers, where the sea is frequently calm enough to permit collecting. In the main the Wrightsville fauna is evidently very similar to that of Beaufort (see the lists in Studies of Biol. Lab. Johns Hopkins Univ., Vol. IV., No. 2, and the list of annelids by Professor Andrews, Proc. U. S. Nat. Mus. Vol. XIV., No. 852). I may add that some of the local collectors would recognize, from a description, many of the striking forms, such as *Chætopterus*, *Chalina arbuscula*, *Leptogorgia virgulata*, all of which may be had here.

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CURRENT NOTES ON ANTHROPOLOGY.

PETRIE'S 'NEW RACE' IN EGYPT.

Two years ago (SCIENCE, August 28, 1895) I described the discovery by Mr. Flinders Petrie in Middle Egypt of remains which he attributed to an invading race about the twelfth dynasty, and which he was inclined to believe were Libyan stock.

Since then there has been considerable discussion of the subject, the general trend of which was in favor of Petrie's view. Dr. G. Schweinfurth, however, in the *Verhandlungen* of the Berlin Anthropological Society for January, attacks this theory, and claims that the remarkable stone artefacts unearthed in the tombs of the 'New Race' are such as are made to-day by the Ababde in the Thebaïs. He is inclined to the belief that the ancestors of these tribes in prehistoric times were the so-called 'New Race' and came from the Bedcha stock, near the coast of the Red Sea.

There are, however, a number of facts overlooked by Schweinfurth which indicate that the 'New Race' were conquerors of an older Egyptian civilization; nor is it likely that the Bedchas would have occupied so exclusively the left bank of the Nile, when their homes were east of its right bank. Petrie's supposition is still the most probable of any offered.

A PHILOSOPHIC SECT.

In the May number of the *Journal of the Anthropological Institute*, Mr. H. Balfour describes the sect of the Aghori fakirs in India. Their doctrine and their practice are based on the philosophic principle of the fundamental equality of all things, and, therefore, they are sticklers for absolute indifferentism. They disregard caste and creed, and receive accessions from the votaries of all religions. They are mendicants and despise property and labor. They eat with indifference carrion, offal or excrement, and as a cup or dish they use a fragment of a human skull, often quite fresh. In creed they are monotheists, believing in one god only, and have no respect for persons except the teacher or *guru*, who has initiated them into the sect. He gives each disciple a name, thus blotting out his past self.

It seems somewhat inconsistent that they should have a form of marriage, but other writers speak of their women as prostitutes. Originally, they seem to have been worshippers of Devi, the wife of Siva, in whose cult obscenity and bestiality were pushed to their furthest extremes.

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NOTES ON INORGANIC CHEMISTRY.

An account is given in *Nature* of the meeting of the International Congress on Technical Education held in London, June 15th–17th. The opening day was devoted to the teaching of chemistry. In one paper Dr. Otto N. Witt, of the Polytechnic School of Berlin, said he could not admit any fundamental difference in the methods of research of pure and applied chemistry; consequently he could not admit the necessity for a difference of instruction for the two. A well-organized instruction in pure chemical science would be the best preparation of any young chemist for his future career. Schools for producing specialists are not wanted; specialism comes as a matter of course in later life. Chemists are needed who embrace their science as a whole, and who are incapable of separating either practice from theory or theory from practice. Dr. Gladstone, speaking of evening schools, said that when the school was situated in the neighborhood of factories it would be allowable and even desirable that the illustrations should be chosen with some reference to the prevailing industry. This is a principle capable of wider application.

In a paper by Professor Lunge, of Zurich, the writer held that, to raise English chemical industry to the foremost rank, it is necessary that the technical management of chemical factories should not be left in the hands of 'rule-of-thumb' men, but should be entrusted to real chemists. These men should have a much fuller education than the majority of chemists seem to obtain at present in Great Britain, which means that they must spend more time and money on their training than they generally do. At college the student should receive a thorough training in scientific chemistry, taking this in its widest meaning, not merely as a 'testing' exercise. Next to this, but not to the same extent, he should be taught physics, mineralogy, technology, mechanics and the elements of engineering. Professor Lunge held that it was unwise for the common workmen or even the foremen to have a knowledge of chemistry or technology, as it is their duty

to simply carry out instructions, and not to meddle with the chemical process itself. Professor Silvanus P. Thompson, in discussing Professor Lunge's paper, urged that where a great industry is localized, science should be applied to that industry, and an institute should be put there devoted to monotechnical rather than polytechnical instruction. Training in research is absolutely necessary, and specific research should not be undertaken too soon by students who have not been taken through an all-round course in chemistry. Sir Henry Roscoe pointed out that England suffers chiefly from the failure of her manufacturers to see, as they ought to see, the importance of the highest scientific training for their employés. Scientific teaching has taken up a sound position already, and if manufacturers will only appreciate its value England can turn out scientific men as well as any country in the world.

THE last *Berichte* of the German Chemical Society contains a series of observations of the amount of carbon dioxid in the air of Sheffield, by W. Carleton Williams. The mean amount found in 142 determinations in the suburbs is 3.266 parts per 10,000, the maximum being 5.14 and the minimum 2.16. The average of 22 determinations in the center of the city is 3.9, with a maximum of 6.22 and a minimum of 2.80. These figures are higher than those observed in Paris (2.85), Dieppe (2.94) and Odessa (3.04), and only equaled by those in Dundee (3.9). As regards the conditions pertaining at the time of the experiment the following conclusions are drawn. During mist and snow the amount is increased; no difference is shown in rainy weather (previous observations on this point differ); a maximum (3.6) is reached in January, decreasing to a minimum (2.59) in April; the amount decreases with the increase of temperature—below 0°, 4.06; 0°–5°, 3.31; 5°–10°, 3.22; 10°–15°, 2.98—possibly due to increased fuel consumption in cold weather; increase with very high or very low barometer. These observations contribute to the view that the amount of carbon dioxid in the atmosphere is by no means constant under varying conditions.

G. SPEZIA contributes to the *Atti* of the Turin Academy an investigation on the action of water on quartz under pressure. Pfaff had shown, using quartz powder, that at 18° and 290 atmospheres' pressure one part of quartz dissolved in 4,700 parts of water; using plates of quartz, Spezia finds that at 25° and 1,750 atmospheres (in one experiment 1,850 atmospheres) in the space of over five months absolutely no quartz went into solution.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE subject of Professor W. P. Mason's address as Vice-President of the American Association for the Advancement of Science (Section C., Chemistry) will be 'Expert Testimony.' The subject of Vice-President L. O. Howard's address (Section F., Zoology) will be 'The Spread of Land Species by the Agency of Man with especial reference to Insects.' The subjects of the other addresses have already been announced in this JOURNAL.

THE party from the zoological department of Columbia University reached Puget Sound, Washington, in the latter part of June, and gave a fortnight to the further exploration of the waters of the Sound. Upon July 8th they started for Sitka, Alaska, where they will remain from four to six weeks, returning to Port Townsend at the close of the season. The party includes Professor Wilson, Dr. Calkins, Professor Lloyd and five others.

PROFESSOR OSBORN has recently returned from a visit to the various parties sent out by the American Mueum of Natural History. The systematic collection of vertebrates this year is extended for the first time among the reptilia, and two parties are working in Kansas and Wyoming. Professor Osborn and Dr. Wort-

man made a survey of the Huerfano Tertiary Lake Basin, in southern Colorado, discovered in 1888 by Professor R. C. Hills, of Denver. The main Museum party has been stationed in the Equus Beds of northwestern Nebraska, where a very complete Pleistocene collection has already been obtained. This department of the American Museum has prepared an exhibit of enlarged photographs of eight mounted fossil skeletons in the Museum, and of twelve restorations designed by Charles Knight, for the International Exposition at Brussels. A similar series will be exhibited at the Geological Congress at Moscow, and at the meetings of the American and British Associations in Detroit and Toronto.

WE learn from *Nature* that the Sydney expedition to Funafuti, to make borings in the coral, projected and led by Professor David, started on June 2d, going by steamer to Fiji, and thence by sailing vessel to Funafuti. This expedition has been made possible by the liberality of the mining department of the government of New South Wales, which has supplied all the boring plant free of cost, and by the munificent gift from Miss Walker, of Sydney, of £500, and from the Hon. Ralph Abercrombie of £100, towards the expense of the expedition.

THE Park Board of New York City have finally adopted the plans of the managers of the Botanical Society for the Botanical Gardens in Bronx Park. R. W. Gibson and the Lord & Burnham Company have been appointed architects. The Board of Estimate has been requested to issue bonds to the amount of $500,000 to defray the cost of erecting the buildings.

DURING a lecture by M. Lacaze-Duthiers, professor of zoology at the Sorbonne, the oxyhydrogen generating apparatus exploded and two of the assistants, MM. Brumpt and Lancepaline were injured, the latter somewhat seriously.

THE Council of the Zoological Society of London have conferred the silver medal of the Society on Mr. Alexander White for his contributions to our knowledge of the fauna of Nyassaland.

ON the occasion of his retirement from the chair of practical chemistry in the School of the Pharmaceutical Society of Great Britain, Professor John Attfield, F.R.S., has been the recipient of a testimonial consisting of an autograph album and silver plate. The former contained the names of eminent scientific men of England and the Continent.

MR. JAMES F. BABCOCK died at Dorchester, Mass., on July 19th, at the age of fifty-three years. He was formerly professor of chemistry in Boston University. During his terms of office as State Assayer and Inspector of Milk he made great improvements in methods of testing. He was the inventor of the fire extinguisher which bears his name, and was well known as a lecturer on popular scientific subjects.

MR. CHARLES F. CROCKER, whose death in San Francisco has been announced, was a regent of the University of California and had made many gifts to public and scientific institutions, including Lick Observatory. His will does not contain public bequests.

THE death is announced of Professor W. Preyer, the eminent physiologist, at Wiesbaden, at the age of 56 years.

WE regret to record the following deaths: M. Chudzinski, professor in the Paris School of Anthropology; Dr. E. Le Gros, professor of physiology at the new University of Brussels, known for his contributions to ophthalmology, aged 36 years; Professor W. Marmé, director of the Pharmacological Institute of Göttingen; Dr. Giuseppe Fissore, sometime professor of pathology in the University of Turin, aged 82 years, and Dr. M. Josef Oertel, professor of medicine at Munich.

THE United States Civil Service Commission announces a competitive examination to fill the vacancy in the position of Supervising Architect of the Treasury. The salary of this position, which is one of the most important and responsible under the government, is $4,000 per annum, and it is hoped that architects of high attainments and reputation may be induced by these considerations to enter the competition. It is the desire of the Department to secure a practical architect of high administrative abillty to direct and supervise the work of the office force as well as the contract work

done on public buildings throughout the country.

IT is reported that the Secretary of Agriculture will ask Congress at its next session to authorize the establishment of an Agricultural Experiment Station in Alaska. Suitable scientific experiments would be of great value in showing what agricultural products and domestic animals could be introduced to advantage.

ACCORDING to the New York *Evening Post*, George A. Brill of Poughquog, Dutchess county, who was graduated from Cornell University in 1888, recently received a cable despatch from Li Hung Chang offering him a liberal sum to organize and manage a model farm in China under the government. He will accept the offer, and will soon leave for China to enter upon his duties.

PROFESSOR BESSEY writes in the *American Naturalist* that he knows from many years of personal experience, and this not in an old and wealthy community, that the purchase of good compound microscopes (duty free), and the installation of small but efficient laboratories in secondary schools, is as easily accomplished for botany as is the purchase of necessary apparatus and the fitting-up of proper laboratories for chemistry. In the new State of Nebraska nearly every accredited high school is now using the compound microscope in the study of plants selected as types of all the greater groups of the vegetable kingdom.

AT the request of Mr. Melvil Dewey, on behalf of the American Library Association, the U. S. government has agreed to issue postal cards of the standard library size for index cards.

THE second International Library Conference was opened on July 13th in London by the Lord Mayor. Sir John Lubbock gave the presidential address. Papers were subsequently presented by Mr. J. T. W. MacAlister, of the Royal Medical and Chirurgical Society of London; by Mr. Henry Tedder, Mr. Herbert Jones, Mr. Alderman Rawson, Mr. Melvil Dewey and others.

AT the recent conversatzione at University College, London, apparatus to be used in a course in experimental psychology was exhibited. The course will be given under the direction of Professor James Sully and Dr. W. H. R. Rivers.

LORD KELVIN has written a letter to the London *Times* stating that in his address at the Pender memorial meeting (quoted in the last issue of this JOURNAL) he inadvertently did serious injustice to the late Sir Curtis Lampson when he said that it was owing to Mr. Pender alone that the Atlantic Telegraph Company was kept afloat from 1858 to 1864. In fact, a large part of the heavy burden of keeping the original Atlantic Telegraph Company alive in the disheartening circumstances of the failure of the 1858 cable, after the short time of its successful working, was voluntarily undertaken by Mr. Lampson when he and Mr. Pender continued to act as directors and nearly all the others, incluing Lord Kelvin himself, resigned.

THE new underground railway in London, extending from Liverpool street to Bayswater, has been an engineering feat of considerable scientific interest. The tunnels are steel tubes 11 feet 6 inches in diameter driven through the clay, each tunnel containing one track. The electric equipment, including the elevators, is supplied from America.

THE *Railway and Engineering Review*, one of the best of the technical journals, publishes in its issue of July 3d an editorial article two columns in length advocating the use of the metric system and maintaining that no great inconvenience would be caused in its practical application.

UNIVERSITY AND EDUCATIONAL NEWS.

THE Pennsylvania Legislature appropriated $200,000 to Lehigh University, and Governor Hastings has signed bills granting $150,000. The funds of Lehigh University are chiefly in stocks of the Lehigh Valley Railroad left by the late Asa Packer and no dividends have been paid for three years.

THE will of the late Alexander Wheelock Thayer gives $30,000 (subject to a small annuity) to Harvard University as an endowment fund to assist poor students.

MR. D. A. BEAMER has given $10,000 to the Laman Missouri Educational Association. The Boston *Transcript*, in announcing this gift, remarks: "The Association has a capital of $20,000, fully paid up, and will establish and operate an up-to-date college of a high order!"

THE following advancements and new appointments in the scientific departments of the University of Texas for the year 1897–'98 have been made: Thomas U. Taylor has been advanced from the grade of associate professor of applied mathematics to that of professor; Dr. Sidney E. Mezes from the grade of adjunct professor of philosophy to that of associate professor; Dr. Henry Winston Harper from the grade of adjunct professor of chemistry to that of associate professor, and W. W. Norman from the grade of adjunct professor of biology to that of associate professor. Dr. Joseph Baldwin, the venerable professor of pedagogy, has been made emeritus professor, and Mr. William S. Sutton, City Superintendent of the Houston Schools, has been elected professor of pedagogy; Mr. E. P. Schoch returns to the University as instructor in chemistry.

AT the Oshkosh Normal School the following appointments have been made: H. Fling, Ph.D., Chicago, to the chair of biology and chemistry; Frank A. Mitchell to the chair of geography; F. D. Sherman, Ph.D., Leipzig, to the chair of pedagogy and psychology.

AT a meeting of the electors to the Savilian professorship of geometry held on July 8th, Mr. William Esson, M. A., F. R. S., fellow of Merton College, was elected professor in the room of the late Professor Sylvester.

MR. ERNEST WILLIAM MACBRIDE, fellow of St. Johns College, Cambridge, and senior demonstrator in the zoological laboratory of the University, has been appointed to the new chair of zoology in McGill University, endowed by Sir Donald A. Smith. Mr. MacBride has held the Hutchinson studentship for research at Cambridge and was awarded the Walsingham Medal in 1895. He has published an important series of Monographs on the Echinodermata.

UNDER the will of Mrs. Gee, widow of the late Robert Gee, lecturer on the diseases of children in the medical school associated with University College, Liverpool, that college receives over £7,000 for the purpose of advancing the medical department and promoting study and research in medical science. It has been decided by the medical faculty to institute a Robert Gee fellowship in anatomy of the value of £100 for one year, and four entrance scholarships of £25 each for one year.

THE Council of St. Hugh's-hall, Oxford, has recently accepted from Miss Clara Evelyn Mordan a donation of £1,000 to found a scholarship to be called by her name.

THE *Lancet* states that Professor Engelman, in taking the late Dr. Du Bois-Reymond's chair at Berlin, is arranging certain changes in the Physiological Institute and its four departments. The first, for microscopical and biological work, will remain under the charge of Professor Fritsch. Similarly, the second, for chemical physiology, will continue under its present director, Professor Thierfelder. The third, for special physiology, will be greatly enlarged, and the professor himself will take part in its work in conjunction with the present director, Dr. Immanuel Munk. The fourth department, for physical physiology, will also be largely increased; it will be called the Department for the Physiology of the Sensory Organs and will remain under the direction of Professor König. In addition to extensive new buildings, the supply of apparatus will be largely augmented. The lectures will be given by the professor in a course running through two semesters, but during the last four weeks in the summer Professor König will lecture on the sensory organs, and during the first four weeks of the winter Professor Thierfelder will lecture on physiological chemistry.

PRESIDENT ANDREWS, of Brown University, has been requested by a committee of the Board of Trustees not to discuss the question of the free coinage of silver, and has consequently been compelled to resign from the presidency of the University. The trustees did not base their action on the supposed evil effects of President Andrews' teaching, but on the alleged ground that the University had, through the

expression of his views, lost gifts and legacies and might lose more. The occurrence is extremely regrettable. It might have been better if President Andrews had not felt called upon to advocate the views of a political party unpopular in Rhode Island, but if the trustees have by their action increased 'gifts and legacies' to Brown University they have done harm to the cause of education. The first part of President Andrews' letter of resignation is as follows:

Believing that, however much I might desire to do so, I should find myself unable to meet the wishes of the corporation as explained by the special committee recently appointed to confer with me on the interests of the University without surrendering that reasonable liberty of utterance which my predecessors, my faculty colleagues and myself have hitherto enjoyed, and in the absence of which the most ample endowment for an educational institution would have but little worth, I respectfully resign the presidency of the University, and also my professorship therein, to take effect not later than the first day of the approaching September.

DISCUSSION AND CORRESPONDENCE.

AMPHIBIA OR BATRACHIA.

Professor Gill in his excellent address 'Some Questions of Nomenclature,' delivered at the Buffalo meeting of the American Association for the Advancement of Science,* makes the following remarks about the name *Amphibia* (p. 600): "Why should the name Amphibia disappear and Batrachia and Reptilia usurp its place? Amphibia is a far better name for the Batrachia, and in every way defensible for it. The name had especial relation to it originally, and it was first restricted to it as a class." In the Editor's Table of the *American Naturalist*, December, 1896, p. 1027, we read the following from the pen of Professor Cope: "It is difficult to eradicate from scientific literature a name or word which has become current, even after it has been found to be an expression of ignorance or error. Thus some names introduced into zoology die hard. Perhaps the most pestilent pretender of the list is the word Amphibia, which is so frequently used instead of the proper name of the class Batrachia. The name Amphibia was originally applied to a combination of the Reptilia and Batrachia, before the fundamental differences between the two were known. When the Batrachia were first separated from the Reptilia the new name was naturally applied to the new division, and the name Amphibia would have been more applicable to the larger division of its former self, *i. e.*, the Reptilia. As, however, its definition accorded with neither the Reptilia nor Batrachia, it was not used for either; nor was it introduced to take the place of Batrachia with a definition, until a few years ago by Huxley. This was done in defiance of the universal usage of naturalists at the time, and probably in ignorance of the real state of the case, since it frequently happens that men engaged in the real work of biological science find questions of names irksome and stupid. Nevertheless it is a distinct advantage always to have but one name for one thing, and that name should be the oldest which was applied to the thing in question as determined by the definition given. Applying this principle, the name Batrachia has a quarter century priority over Amphibia."

I shall show that the opinion of Professor Gill is the only one that can be accepted.*

In the 10th edition of Linné† we have the following:

Classis III. *Amphibia.*

I. *Reptiles* os respirans: Pedes quattuor.

103, *Testudo*; 104, *Draco*; 105, *Lacerta*; 106, *Rana.*

II. *Serpentes,* os respirans, Pedes Pinnæve nullæ.

107, *Crotalus*; 108, *Boa*; 109, *Coluber*; 110, *Anguis*; 111, *Amphisbæna*; 112, *Cæcilia.*

III. *Nantes,* Spiracula lateralia, Pinnæ natatoriæ.

113, *Petromyzon*; 114, *Raja*; 115, *Squalus*; 116, *Chimæra*; 117, *Lophius*; 118, *Acipenser.*

The next author of importance to be mentioned is Alexandre Brogniart. His 'Essai

* Science, N. S., Vol. IV., No. 95, Oct. 23, 1896, p. 581–601.

*Nine years ago I followed Cope (Beiträge zur Morphogenie des Carpus und Tarsus der Vertebraten I. Theil. Batrachia. Jena, Gustav Fischer), but later I found that I was mistaken.

† Caroli Linnæi Systema Naturæ. Tomus I. Editio Decima, Reformata Holmiæ. 1758. Pp. 194–238.

d'une classification naturelle des Reptiles', was published in 1799.*

Brogniart divides the Reptiles into four orders: *Chéloniens*, *Sauriens*, *Ophidiens*, *Batraciens*, and gives the following characters: (Bull. Sciences Soc. Philom, No. 35, pp. 81–82. 1800):

"1er Ordre: Les *Chéloniens* (il renferme les tortues). Ces Reptiles n'ont point de dents enchâssées, mais leurs mâchoires sont enveloppées de gencives cornées tranchantes, leur corps est couvert d'une carapace. Il est bombé. Ils ont deux oreilettes au cœur, un estomac plus volumineux que les autres reptiles, un canal intestinal garni d'un cæcum, ils s'accouplent et pondent des oeufs à coquille calcaire solide. Ils se nourissent en' grande partie de végétaux."

2e Ordre: Les *Sauriens* (renferment les crocodiles, iguane, dragon, stellion, gecko, caméléon, lézards, sinque, chalcide).

Tous ces animaux ont des dents enchassées, deux oreilettes au cœur, des côtes et un sternum, le mâle n'a un organe extérieur de génération; ils s'accouplent réellement, pondent à terre des oeufs à coquille calcaire, d'où sortent des petits qui ne subisent pas de métamorphoses. Ils ont des plaques écailleuses ou des écailles sur le corps.

3e Ordre: Les *Ophidiens* (renferment les genres connus sous le nom général de serpents).

Ils se rapprochent plus des reptiles des premiers ordres que de ceux du quatrième, comme eux ils ont de longues côtes arquées, le mâle a un organe extérieur de génération, ils s'accouplent réellement et pondent des oeufs á coquille calcaire d'où naissent des petits en tout semblable à leurs parents; mais ils différent des Sauriens, parce qu'ils n'ont qu'une oreillette au cœur, point de sternum, que les mâles ont une verge double, quils pondent des oeufs à coquille calcaire molle et qu'ils n'ont point de pattes.

4e Ordre: Les *Batraciens*, (contenant les crapauds, les raines, les grenouilles et les salamandres).

Ces animaux différent autant des trois premiers ordres, qu'ils se conviennent entre eux, et l'auteur prouve que les salamandres qu'il a placées dans cet ordre, n'ont d'autre analogie avec les lézards, parmi lesquels on les avait mises, que d'avoir comme éux le corps allongé, des pattes et une queue.

Tous ces reptiles ont d'ailleurs une seule oreillette du cœur, points de côtes ou seulement des rudiments de ces os, la peau nue et des pattes, le mâle n'a aucun organ extérieure de génération et il n'y a point d'accouplement réelle, la plus part du temps les oeufs, sont fécondés hors du corps de la femelle. Ces oeufs sont sans coquille et pondus dans l'eau; les petites qui en sortent ont des branchies à la manière des poissons, et différent de leurs parents pendant les premiers moments de leur vie, ils se rapprochent par cela même des poissons; ces animaux doivent donc être placés dans l'ordre naturelle de la fin de la classe des Reptiles et immédiatement avant celle des poissons."

The close relationship between the frogs and toads and the salamanders had already been observed by Laurenti (1768) and Lacépède (1788–89), but they did not make any use of this fact in their classifications. It is the merit of Brogniart to have united these forms in a single order of his reptiles, which he called *Batraciens*. At the same time it is evident that he did not oppose the order Batraciens to the rest of the *Reptiles*, but gave it the same value as to the single orders *Chéloniens*, *Sauriens* and *Ophidiens*.

The first Latin names were given to these orders by Treviranus in 1802 and by Shaw in the same year.

Treviranus* uses the name *Amphibien* for the

*Brogniart, Alexandre, Essai d'une classification naturelle des Reptiles. Magazin encyclopédique ou Journal des Sciences, des Lettres et des Arts, rédigé par A. L. Millin. Tome V., pp. 184–201, 1799, reprinted in Bulletin des Sciences, par la Société Philomatique, No. 35, Iere Partie, pp. 81–82, Paris, Pluviose, an 8 de la République. IIe Partie No. 36, pp. 89–91, pl. VI. Ventose, an 8 de la République. (January 21st–March 19th, 1800.) The same paper, more extensive, was published in Mémoires présentées à l'Institut des Sciences, Lettres et Arts, par divers Savans, et dans les Assemblées. Sciences mathématiques et physiques, Vol. I., pp. 587–637, 2 pl., Paris, XIV.—1805; also separate, Paris, Baudouin, Imprimeur de l'Institut National. Prairial An XIII.—1805.

* Treviranus, Gottfried Reinhold, Biologie, oder Philosophie der lebenden Natur für Naturforscher und Ärzte. Bd. I., pp. 260–265 Göttingen, 1802.

whole group, and following Brogniart he divides it in four orders:

I. Schildkröten. *Testudines.*
II. Eidechsen. *Lacertæ.*
III. Schlangen. *Serpentes.*
IV. Frösche. *Ranæ.*

Shaw * uses the same names for the four orders of his *Amphibia* in the following order: I. *Testudines.* II. *Ranæ.* III. *Lacertæ.* IV. *Serpentes.*

We see the *Latin* name *Batrachia* was not used at all by Brogniart, as stated by Professor Cope in 1889 (Batrachia of North America, p. 17). The first *Latin* name for the order is *Ranæ*, Treviranus, and if we would follow Cope's opinion about this question we should have to call the class *Amphibia Ranæ*.

In 1804 Latreille † published his 'Tableau méthodique des Reptiles.'

Classe troisième.
Reptiles, REPTILIA.

I. Des pattes, ayant des doigts onguiculés, ou point des pattes; jamais de branchies ni de métamorphose.

Ordre I. *Chéloniens*, CHELONII.	Des pattes; corps enveloppé dans une boîte osseuse.
Ordre II. *Sauriens*, SAURII.	Des pattes; corps nu.
Ordre III. *Ophidiens*, OPHIDII.	Point des pattes.

II. Doigts des pattes n'ayant pas d'ongles; des branchies, du moins pendant un temps; de métamorphose.

Ordre IV. *Batraciens*, BATRACHII.

We see, that Latreille divides the Reptilia in two groups, without giving special names to them. The first group contains the Orders *Chelonii* (*Testudines*, Treviranus, Shaw, 1802), *Saurii* (*Lacertæ* Treviranus, Shaw), and *Ophidii* (*Serpentes* Treviranus, Shaw); the second one the order *Batrachii** (*Ranae* Treviranus, Shaw).

Two years later, in 1806, C. Duméril † used the Latin names: Class, *Reptilia*, with the orders, *Chelonii*, *Saurii*, *Serpentes*, *Batracii.*

Gravenhorst, ‡ in 1807, calls the orders: *Chelonia*, *Sauria*, *Ophidia*, *Batrachia.* §

Oppel ‖ opposed the 'Batraciens' to the other Reptilia, as can be seen from his diagnosis, but he did not give any special names to the combined opposed orders.

Classis REPTILIA. Animalia vertebrata; pulmonibus; sanguine frigido; pilis, mammellis, plumisque carentia.

Corpus
- obtectum
  - testa, sternoque .... I. *Testudinata* (Klein).
  - squamis, costis proprie dicti .... II. *Squamata* (Oppel).
- nudum, *i. e.*, nec testa, nec squamis; genitalia exteriora nulla; metamorphosis... III. *Nuda* (Klein).

Oppel was also the first one who placed the *Cœcilians* in the Amphibia; he also placed *Anguis* in the *Lacertilia.* The affinity between *Anguis* and the *Lacertilia* had been recognized, however, already one year before by *Lehmann.* ¶

Now follows the important paper of de Blainville, ** published in 1816. He divides the reptiles into two classes or subclasses, as will be seen from his diagram.

* Shaw, George. General Zoology or Systematic Natural History, Vol. III., Part I., Amphibia, p. 5. London, 1802.

† In the Nouveau Dictionnaire d' Hist. Nat., Vol. 24, p. 61.

*This is the first occurrence of the Latin form of Batraciens Brogniart.

† Duméril, Constant. Zoologie Analytique ou Méthode Naturelle de classification des Animaux. Paris, MDCCCVI., pp. 74–95.

‡ Gravenhorst, I. L. C. Vergleichende Übersicht der Linneischen und einiger neueren zoologischen Systeme. Göttingen, 1807, p. 397.

§ This is the first use of the name Batrachia.

‖ Oppel Michael. Die Ordnungen, Familien und Gattungen der Reptilien als Prodrom einer Naturgeschichte derselben. München, 1811, 86 p.

¶ Lehmann, C. D. W. Über die Zerbrechlichkeit der Blindschlangen und die Übereinstimmung des inneren Baues derselben mit den Eidechsen. Magaz. der Gesellsch. Naturf. Freunde. I-Berlin. Jahrg. IV., pp. 14–31, 1810.

**Blainville, H. de. Prodrome d'une nouvelle distribution systematique du règne animal. Bulletin des Sciences par la Société Philomatique de Paris. Année 1816, pp. 113–124.

Classes III. et IV. *Reptiles* Hétéro ou Erpétozoaires. Squammifères et Nudipellifères.

Ire Sous-Classe *Ornithoïdes,* Ecailleux. ou IIIe Classe *Squammiferes.*	O. I. *Chéloniens* ou Tortues.	
	O. II. *Emydo-Sauriens,* ou Crocodiles.	
	O. III. *Bispeniens*	Ier Sous-O. Sauriens.
		IIe Sous-O. Ophydiens.
IIe Sous-Classe *Ictyoïdes* Nuds ou IVe Classe *Nudipelliferes*	O. I. Batraciens, ou Grenouilles.	
	O. II. Pseudosauriens, ou Salamandres.	
	O. III. Amphibiens, ou les Protées et les Sirènes.	
	O. IV. Pseudophidiens, ou Cœcilies.	

De Blainville makes the following very interesting remarks:

Les noms d'*Ornithoïdes* et d' *Ictyoïdes* employés dans le cas ou les reptiles seraient considerés comme une seule classe, indiquent que les premiers sont formés d'après le plan des oiseaux, et les seconds d'après celui des poissons. P. 119.

Merrem * (1820) divides the *Amphibia* Linné into two classes:

1. *Pholidota:* Corpus *pholide tectum.*

The *Pholidota* contain the orders: *Testudinata, Loricata, Squamata.*

2. *Batrachia:* Corpus *glabrum* aut *verrucosum.*

The *Batrachia* the orders: *Apoda, Salientia, Gradientia.*

The group *Amphibia* Linné is still retained, but it is divided into two classes: *Pholidota* and *Batrachia.*

Two years later, in 1822, de Blainville † separated completely the Amphibia from the Reptilia. Here is his general classification of Vertebrates (plate 2):

TYPE I.

OSTÉOZOAIRES ou A. VERTÉBRÉS.

Sous—Type I.	*Vivipares.*
Homme.	
Piliféres.	MAMMIFÉRES.
Sous—Classe I.	*Monodelphes.*
Sous—Classe II.	*Didelphes.*
Sous—Type II.	*Ovipares.*
Pénniféres.	OISEAUX.
Squammifères.	REPTILES.
Nudipellifères.	AMPHIBIENS.
Pinnifères.	POISSONS.

The special classification of the *Reptilia* and *Amphibia* is given in the following (plate 5).

Type I, OSTÉOZOAIRES.

Sous-Type II, OVIPARES.

Classe IIIe; les REPTILES.

REPTILES
- Ier degré d'organisation ou ordre CHÉLONIENS, ou Tortues. Les doigts
  - réunis en moignon, les *T. terrestres* (Tortue)
  - distinct, peu palmés, les *T. de marais* (Emyde, Chelyde)
  - distinct et bien palmés, les *T. de fleuves* (Trionix)
  - réunis en nageoir les, les *T. marines* (Chélonée, Demochélyde,
- IIe degré d'organisation ou ordre EMYDOSAURIENS, ou Crocodiles. Le museau
  - large et cour, Les *Caimans*
  - un peu long, les *Crocodiles*
  - très long, les *Gavials*
- IIIe degré d'organisation ou ordre SAUROPHIENS ou Bispéniens
  - Ier Sous-Ordre *Les Sauriens*
    - Les *Geckoïdes*, Les *Agamoïdes*, Les *Iguanoïdes*, Les *Tubinambis*
      - normaux, Agame, Basilic, etc.
      - anomaux
        - p. grimper
        - Caméléon
        - p. voler Dragon
    - Les *Lacertoïdes* ....
      - Tétrapodes
      - Dipodes
      - Apodes
  - IIer Sous-ordre Les *Ophydiens*
    - *Dipodes*.............................*Bimanes*
    - Apodes
      - sans dents vénim La quesu
        - conique
          - *Amphisbêne*
          - Grimpeurs ou *Boas*
          - *Couleuvres*
        - comprimie, *Pêlamides*
      - poruvus de dents vénim La queue ..
        - comprimie *Hydrorhides*
        - conique
          - *Viperes*
          - *Léthiféres*

* Merrem, Blasius. Tentamen Systematis Amphibiorum. Marburgi, MDCCCXX.

† Blainville, Ducrotay de, De L'organisation des Animaux, ou Principes d'Anatomie Compareé. Tome I. Contenant la Morphologie et l'Aistésologie Paris, 1822 (pl. 2 and pl. 5 at the end of the volume). This is the only volume that has been published.

Classe IV^e; LES AMPHIBIENS

AMPHIBIENS
- I[er] degré d'organisation ou ordre BATRACIENS .... Sous-ordre
  - I. *Aquipares.* Rainette, grenouille, Crapaud
  - II. *Dorsipares.* Pipa.
- II[e] degré d'organisation, ou ordre PSEUDOSAURIENS, ou Salamandres.
- III[e] degré d'organisation, ou ordre SUBICHTHYENS. Les Protées, Sirènes.
- IV[e] degré d'organisation ou ordre PSEUDOPHYDIENS, ou Coecilies.

Three years later Latreille* used the Latin names *Reptilia* and *Amphibia* for de Blainville's classes *Reptiles* and *Amphibiens*, and these names ought to be used. Gray† in the same year, but later used the same names as distinct classes.

This name is used to-day all over Europe, France excepted.

Latreille's characters are the following:

P. 90. "*Première Classe.* REPTILES. REPTILIA.

"Ils ne respirent, et en tout temps, que par des poumous. Le cœur a deux ventricules et deux oreillettes. Les mâles ont une verge quelquefois double ou fourchue et s'accouplent. Plusieurs sont sujets á des mues complètes, ou se défont de leur peau, mais aucun n'éprouve de métamorphose. Le corps est plus souvent garni d'écailles ou emboîté; les pieds sont toujours armés d'ongles très-sensibles. La coque des oeufs est dure ou du moins coriace."

P. 103–14. "*Seconde Classe. Amphibiens.* AMPHIBIA.

"Ici les deux poumons sont accompagnés, soit dans le jeune âge, soit pendant toute la vie, de branchies. Le cœur n'a qu'un ventricule et qu'une oreilette, tant que les branchies persistent, un tronc artériel et dorsal tient lieu du ventricule qui manque, savoir la gauche il est remplacé, lorsqu' elles disparaissent, par une artère dorsale. Les mâles n'ont point de verge. L'accouplement n'est que similué, c'est-à-dire qu'il ne consiste que dans de simples embrassements, durant lesquels les mâles fécondent les oeufs, á mesure qu'ils sortent. Les petits naissent sans pattes, et subissent de véritables métamorphoses. La peau est toujours nue, et les ongles des pieds sont nuls ou rarement sensibles. Les oeufs sont réunis, et leur coque est membraneuse. Ces animaux vivent pour la plupart dans les eaux ou les lieux humides."

FEBRUARY 14, 1897. G. BAUR.

* Latreille, Pierre André, Familles naturelles du régne animal, Paris, 1825, pp. 90–103.

† Gray, John Edward. A synopsis of the genera of Reptiles and Amphibia with a description of some new species. The Annals of Philosophy, New. Ser., Vol. X. London, Sept., 1825, pp. 194–213.

CORRECTION CONCERNING MR. RHOADS' USE OF THE NAME BASSARISCUS RAPTOR (BAIRD).

IN a recent paper in the Proceedings of the Biological Society of Washington* I quoted two statements, which were in part contradictory, from a paper by Mr. S. N. Rhoads respecting the proper name for the Oregon Bassarisk. In so doing I made a stupid blunder, for one of the statements in question was quoted by Mr. Rhoads, whose own remarks in this particular were not inconsistent.

C. HART MERRIAM.

*Proc. Biol. Soc. Wash., XI., 186, July 1, 1897.

SCIENTIFIC LITERATURE.

Report on Vital and Social Statistics in the United States at the Eleventh Census, 1890. Part II., Vital Statistics. Cities of 100,000 Population and Upward. By JOHN S. BILLINGS, M.D. Washington, 1896 [Received May, 1897], pp. 1181.

Now that statistical studies of variation and

the phenomena of life are coming into so much favor among students of evolution, the present volume possesses a distinct value as a biological treatise, in addition to its obvious practical utility. It may serve at once as an encouragement and a warning to ardent statisticians, because, while many of the facts it sets forth are important and interesting, the closer it is studied the stronger grows the conviction that vital statistics need to be examined with extraordinary caution before being accepted at their 'face-value.' *Homo sapiens* is an animal whose habits are better known to us than those of any other, and we have exceptional facilities for estimating the factors which control his development and evolution. Accordingly, we readily perceive the more important probable sources of confusion in the statistics, as, for example :

(1) The 28 cities of the size indicated in the title had an aggregate population of 9,697,960, of which 4,850,653 were males and 4,847,307 females. Thus it might be inferred that the males of the human species were more numerous than the females, but for the recollection that large cities attract great numbers of men who either have no families or leave them elsewhere. Taking the cities separately, the majority had more females than males, but the following eleven had an excess of males: Buffalo, Chicago, Cleveland, Denver, Jersey City, Kansas City, Minneapolis, Omaha, Pittsburg, St. Louis (white) and St. Paul. It is significant that while Omaha had a population of 80,108 males and only 60,344 females, those under one year of age consisted of 1,411 males and 1,422 females, showing an excess of female births, in accordance with current expectations.

It is, however, very remarkable to find that in a number of cities there was an excess of male babies under one year of age, showing apparently an excess of male births. Thus Jersey City had 2,007 males and 1,966 females under one year; Chicago had 15,281 males and 14,823 females under one year. But this result is further complicated by the fact that there was a considerable excess of male mortality under one year; thus in Chicago the deaths under one year were 233.95 males and 190.72 females per 1,000 population of corresponding age. In every city the male mortality under one year exceeded the female, often greatly exceeding it. Thus including still-births, we get the following striking results:

Total deaths under one year.

	Males.	Females.
Buffalo,	1,069	817
Cleveland,	1,155	835
Philadelphia,	3,707	3,055
New Orleans,	1,084	844
and so forth.		

Now how are we to account for an excess of male births, combined with a remarkable excess of male mortality, during the past year? I have heard it stated that the slightly larger average size of the male head leads to an increase of the number of still-births, but this obviously will only account for a small proportion of the facts here before us. It seems to the present writer that some light may be thrown on the problem by the theory, adopted by some biologists, that the sex is determined at an early age by the conditions of the nutrition of the germ, favorable conditions producing a preponderance of females, unfavorable of males. If this is so, immediately we see the meaning of the above statistics. Omaha, which was the most healthy of the towns discussed, according to the data given, had an excess of female babies; other cities, notoriously containing unhealthy and crowded wards, show an excess of male babies. Further, if disadvantageous conditions lead to an excess of males, it is easy to understand why those males, on the average, should be less able to survive the first year. Hence the excess of male deaths, even when there was an excess of female births. It is to be supposed that those families and wards in which occurred the greater part of the male deaths would show an excess also of male births, though the city as a whole might not show it.

(2) Comparing 1880 with 1890, there is shown a great increase of infant mortality. Thus, for example:

Proportion of deaths under 1 year per 1000 births.

Newark,	under	150	in	1880,	over	250 in 1890
Jersey City,	"	175	"	"	"	225 " "
Denver,	"	125	"	"	"	200 " "
Rochester	"	100	"	"	"	150 " "
and so forth.						

Only three or four cities showed improvement, the most marked being St. Louis.

In studying these facts, there seems to be no escaping the conclusion that infant mortality in the large cities is largely on the increase, but it is probable that meteorological conditions may have affected the statistics, *e. g.*, it was perhaps wetter in 1890 than in 1880. However, on examining the causes of mortality for the two years, we get clearer evidence. 1890 shows a decided increase in 'inanition,' and also 'debility and atrophy.' There is also a marked increase in bronchitis and pneumonia. There is a decrease in convulsions and also in cholera infantum as compared with 1880.

(3) It appears that the colored have an almost uniformily higher death-rate than the whites; and this, as a general rule, is no doubt true; but the negro is known to be less susceptible to malaria than the white, yet, owing to his mode of life, his mortality from this cause is much greater in the cities discussed. Again, it appears from the tables that the death-rate of the native whites is greater than that of the foreign whites in most cities, but, as Dr. Billings points out, this must be connected with the fact that the native whites include a much larger proportion of young children. It is interesting to note that in New Orleans the death-rate of the foreign whites was much greater than in any other of the cities, while that of the native whites was less than in many of the cities. In connection with this we observe that the death-rate from malaria in New Orleans was more than double that in any other of the cities, and that it was much greater among the foreign whites; hence it is fair to assume that the native whites of New Orleans exhibit the results of evolution against this disease.

It may be here remarked that the mortality from typhoid fever was greater in the great cities of the United States than in those of England, France or Germany; and in the United States the foreign-born suffered markedly more from this disease than the native-born. Hence perhaps we may assert that the natives of the United States exhibit the results of evolution against typhoid an evolution more marked than that of European nations.

The death-rate of the colored from consumption was more than twice as great as that of the whites. Curiously, it was about twice as great among the children of mothers born in Ireland as among those of mothers born in Germany, and more than three times as great as among those of mothers born in the United States. This may be largely due to the manner of life of the Irish, but it does appear that they are naturally more susceptible to this disease than Germans or Americans. Erroneous conclusions might be drawn from the fact that Denver has a much higher death-rate from consumption than Pittsburg or Kansas City, did we not remember that very many consumptives go to Denver and die there.

In another part of the book are given colored maps of the cities, showing by different degrees of shading the death-rates in the several wards. Information is also given which enables one to form some opinion as to the causes of the remarkable differences between the healthfulness of the wards in all of the cities. These and many other matters might be discussed at length, but enough has been said to show that Dr. Billings' volume should be of great value not only to social reformers, but also to biological students. It may be that in the study of the facts these different classes of individuals will find a common ground, and the teachings of science will ultimately be heard in no uncertain way from the political platform, setting forth truths which will surprise many comfortable and self-satisfied individuals.

T. D. A. COCKERELL.

MESILLA, N. M., June 25, 1897.

GEOLOGIC ATLAS OF THE UNITED STATES. FOLIO 24, THREE FORKS, MONTANA, 1896.

THIS folio, by Dr. A. C. Peale, consists of 5 pages of text, a topographic sheet (scale 1:250,000), a sheet of areal geology, one of economic geology, one of structure sections, and one giving a generalized columnar section for the district.

The area covered comprises the square degree which lies between the meridians 111° and 112° and the parallels 45° and 46°, in the south-western, mountainous portion of Montana, and includes 3,354 square miles. In the extreme

southeast corner the Yellowstone National Park barely falls within the area. The folio derives its name from the valley in which the Jefferson, Gallatin and Madison rivers unite to form the Missouri. The 'Three Forks' Valley is important from an historic standpoint, as being the point which Lewis and Clark reached in July, 1805, when they named the three confluent branches of the Missouri.

The text begins with a general description of the geography and topography of the region, and then takes up the general geology. The oldest rocks in the region are the crystalline schists and gneisses, designated as of Archean age, which in pre-Cambrian time formed a land mass comprising nearly all the area included in the map. While the Algonkian beds were being deposited to the extent of from 6,000 to 12,000 feet, there was a gradual subsidence of the whole region, and shallow seas for the most part prevailed. During the Paleozoic age there were many minor oscillations of the surface, which were more frequent during Cambrian time than during the deposition of the Devonian and Carboniferous limestones. Toward the close of the Cretaceous period a general elevation began, which was accelerated after the deposition of the Laramie formation. The formation of the mountain ranges, together with the subsequent erosion, resulted in many valleys, which eventually were occupied by fresh-water lakes. These lakes attained their greatest extent in the Neocene period, lasting in all probability until the Pleistocene period was well advanced, and during their earlier stages immense bodies of wind-carried volcanic dust were deposited in their waters, and are now seen as beds of pure white dust. At the same time the dust fell upon the surrounding country, from which it was afterward washed into the lakes, forming an upper series of yellowish and rusty-colored beds. These dust showers destroyed both animal and vegetable life, and the remains carried into the lakes were buried in their deposits, where they are now found as fossil bones and opalized and silicified wood.

Under the 'Description of Rock Formations, are outlined all the formations from the Archean gneisses up through the Algonkian, Cambrian, Devonian, Carboniferous, Juratrias, Cretaceous, Eocene, Neocene and Pleistocene. The rocks of more than half of the area are of sedimentary origin, while the crystalline rocks occupy approximately 1,000 square miles, the remaining third of the area being covered with igneous material. Prominent among the latter are the andesitic breccias which form the main part of the Gallatin Range, the great porphyritic laccolite occupying the center of the Madison Range, and the basaltic plateau which lies west of the Madison Valley.

Under the heading 'Structural Geology,' after a general consideration, the vertical and horizontal movements are discussed, and the development of the lake basins is described. The arrangement of the rock masses is complex, the structure being complicated by laccolites, dikes and surface flows of igneous material. Unconformities exist, showing that areas previously raised to land surfaces and worn down have subsided, have been crossed by an advancing shore, and later have passed beneath the sea.

The lake basins are now the floors of extensive valleys separating the detached mountain ranges, which rise about 6,000 feet above their bases. As the lake deposits are at least 2,000 feet in thickness, the difference of elevation between the bottoms of the lake basins and the summits of the peaks must be at least 8,000 feet. The region was a mountainous one before the development of the lakes; but in the evolution of the existing relief, movements and erosion have both operated to accent the topographic differences.

The principal economic resources of this region are gold, silver, iron ore, copper, limestone and coal. The occurrence of coal in Devonian rocks on the north side of Jefferson Cañon is of geologic interest, although not of much economic importance. The fine pumiceous volcanic dust found in the old lake basins has been utilized to a very limited extent as a polishing material. Brick clays occur and are used to a small extent in a number of localities, especially near Bozeman. In addition to the economic resources just referred to, the sheet of economic geology has indicated upon it the localities of building stone and mineral springs.

GEOLOGIC ATLAS OF THE UNITED STATES. FOLIO 30, YELLOWSTONE NATIONAL PARK, WYOMING, 1896.

THE Yellowstone Park folio, recently issued, consists of six pages of descriptive text, three pages of illustrations, four topographic sheets (scale 1 : 125,000), and four sheets delineating the areal geology of the region.

The general descriptive text, giving a succinct narrative of the geological history and development of the Park country from the time of the earliest continental land surfaces up to and including the hydro-thermal phenomena as seen to-day, was written by Arnold Hague, geologist in charge. It is followed by an account of the sedimentary rocks from the earliest Cambrian deposits to the Tertiary conglomerates, by Walter Harvey Weed, and a detailed petrographical description of the igneous rocks, by Joseph Paxson Iddings.

The area of country covered by the Yellowstone National Park folio lies between parallels 44° and 45°, and meridians 110° and 111°. It is situated in the extreme northwest corner of Wyoming. By far the greater part of the Park is included within the area of the four atlas sheets, but a narrow strip lies to the northward in Montana, and a still narrower strip extends westward into Idaho and Montana. In the organic act establishing the Park, Congress declared that the reservation was 'dedicated and set apart as a public park and pleasure ground for the benefit and enjoyment of the people.' Owing to the marvelous display of geysers and hot springs of the region, and such remarkable physical features as the Grand Cañon and Yellowstone Lake, this folio possesses more than ordinary interest to geologists.

The central portion of the Yellowstone Park is a broad volcanic plateau with an average elevation of 8,000 feet, surrounded on nearly all sides by mountains rising from 2,000 to 4,000 feet above its general level. The continental watershed crosses the Park, separating the waters of the Atlantic from those of the Pacific, the Missouri and the Columbia, by the way of the Yellowstone and the Snake, finding their sources on this plateau.

The oldest rocks of this region are granites, gneisses and schists regarded as of Archean age. They occur in all the mountain uplifts that encircle the Park, but are unknown in the central portion. Around these ancient continental land masses there was deposited a conformable series of sandstones, limestones and shales, extending from the time of the middle Cambrian, the lowest beds exposed through the upper Cambrian, Silurian, Devonian, Carboniferous Juratrias and Cretaceous, including the Laramie sandstone. Nearly every one of these great divisions of Paleozoic and Mesozoic time is characterized by a typical fauna. With the close of the deposition of the Laramie sandstone the conformable series of sediments came to an end. The entire region was elevated above the sea, the elevation being accompanied by plication and folding of strata. This primary orographic uplift which blocked out the main ranges of the northern Rocky Mountains has been designated the post-Laramie movement.

Tertiary sedimentary rocks occupy only small areas in the Park, the greater part of the region being covered by extensive flows of lava. A heavy mass of coarse conglomerate, designated the Pinyon conglomerate, has been referred to the Eocene, and Pliocene conglomerate and coarse sands are well exposed in the escarpments of the Grand Cañon.

Volcanic energy, which has played a great part in the geological development of the country, was connected with the post-Laramie movement and followed closely upon the elevation of the mountains and the accompanying dislocation and compression of strata. The eruptive masses in forcing their way upward sought egress along lines of least resistance, or wherever strain had been greatest in the crumpled sediments. Volcanic outbursts continued on a grand scale throughout Tertiary time.

During the Eocene and Miocene periods enormous volumes of fragmental ejectamenta, largely composed of andesitic breccias, were thrown out. The Absoraka Range was almost wholly built up of volcanic material. Evidence of this long-continued action is shown in the well-preserved fossil floras of Eocene and both lower and upper Miocene age. The famous fossil forests of the Yellowstone are of Miocene age. After a period of great erosion the depressed basin lying between

the encircling ranges was transformed into the present Park Plateau by the extravasation of immense flows of rhyolite of Pliocene age. Still later the recent basalts, the last of the igneous extrusions, poured out over the rhyolite along the ridges of the plateau. A vertical section accompanies the text, showing the order of succession of the extrusive flows from the earliest outbursts to the final dying-out of eruptive energy. It is shown that long-continued currents of heated waters and acid vapors have acted as powerful agents in decomposing the igneous rocks of the plateau, and date back to Pliocene time; at least they were active before glacial ice covered the country. Hot springs, geysers and solfataras are closely associated with the rhyolite, and in fact thermal activity is confined almost exclusively to areas of this rock.

The illustrations relate mainly to the occurrence of both active and dormant geysers and hot springs, or some phase of volcanic geology. The Grand Cañon, well shown in the illustrations, is a profound gorge cut in the Pliocene rhyolite, the brilliant coloring being due to the action of thermal waters.

An Illustrated Flora of the Northern United States, Canada and the British Possessions. By NATHANIEL LORD BRITTON and HON. ADDISON BROWN. Volume II. Portulacaceæ to Menyanthaceæ. New York, Charles Scribner's Sons. Pp. 643. $3.00.

The elaborate review of the first volume of Britton and Brown's 'Illustrated Flora of the Northern United States,' which was given by Professor Conway MacMillan in SCIENCE, renders necessary only a brief notice of the second volume, which has now appeared.

Following the Engler and Prantl sequence, the first volume was made up chiefly of the monocotyledonous plants, which, compared with the other large groups of flowering plants, are probably the least attractive. In the present volume are included such large and well-known families as the Pink family, Crowfoot family, Mustard family, Rose family, Pea family, Carrot family, and the Heath family. As a whole the volume exceeds in interest and attraction the earlier one.

In running through the book a leading feature of excellence impressed upon one is that there are brought together here for the first time in a systematic manner the results of all the recent scattered special papers on our North-eastern plants. For example, the critical work done in the past few years on *Amelanchier Canadensis*, *Cardamine hirsuta*, *Ranunculus repens* and *Agrimonia Eupatoria* is here found carefully collated and systematized, full consideration being given to the conclusions of those who have done the work and whose opinions are therefore most to be depended upon.

A liberal view has been maintained regarding the delimitation of species, the work in this respect standing alone among our recent manuals. There has been a tendency among our manual writers, in case of any difficulty in the definition of specific types, to follow the antique British method of giving up any attempt at segregation and putting a number of diverse forms under one name. The results of the endeavor to give full consideration to valuable critical work is exceedingly gratifying, and will certainly serve to encourage in botanists habits of close observation on our supposedly well-known Eastern flora. No better example of judicious segregation could be cited than the separation from the old *Ranunculus repens* of three additional species, *R. septentrionalis*, *R. hispidus* and *R. macounii.*

In the matter of generic treatment this volume gives a similar impression of liberality, the limitation of genera corresponding very closely in this work with that of continental European authors. As extreme examples of the extent to which the generic segregation has been carried may be cited *Œnothera*, which is here divided into eleven genera. It is clearly a recognized principle throughout the work not merely that a genus is a group which can always be recognized by some one or more invariable technical characters fitting nicely in a key, but that it is a group of plants which resemble each other in what is perhaps best represented in English by the word *style*, and that the question of an arbitrary mark, as it were, is of secondary, not of primary importance.

The drawings, for which the book is most likely to be criticised by botanists of critical

training, are usually excellent, and to the ordinary student, for whose guidance they were evidently more especially intended, they must always prove valuable. The drawings of the violets, for example, are excellent and helpful representations of the different species of that group. In the case of the genus *Myriophyllum* in which the drawings have less of sharpness and more of the character of sketches, the species, which everyone has had difficulty in understanding from mere descriptions, can be readily recognized from the drawings.

Probably the principal fault in the general make-up of the work lies in the separation of the Latin and English indexes, a system which if carried through the third volume would sometimes make it necessary for one unfamiliar with botanical names to look in six different indexes in order to find a particular plant. It is to be hoped that the third volume will contain a single combined Latin and English index to all three volumes.

The impression is strengthened by this second volume that this work marks an epoch in the development of systematic botany in America, combining, as it does, the best of the new ideas which have been current in this country for twenty years and which had their source in the new method of systematic research in which the younger generation had been educated, based on the Darwinian ideas of genetic development.

F. V. COVILLE.

SCIENTIFIC JOURNALS.

TERRESTRIAL MAGNETISM FOR JUNE.

THE first article, by Dr. J. A. Fleming, on 'The Earth a Great Magnet,' gives a popular exposition of the principal phenomena of the earth's magnetism. For many years it has been the custom to have a popular experimental or illustrated lecture delivered during the meeting of the British Association for the Advancement of Science, addressed especially to the artisans of the town in which the meeting takes place. This article gives the text of the discourse delivered by the author before the workingmen of Liverpool at the last meeting of the British Association. Dr. Fleming's most admirable lecture was profusely illustrated by experiments, and was presented before a very large audience in the Picton Hall. It appears in *Terrestrial Magnetism* in full for the first time.

Professor McAdie reviews and summarizes the present state of our knowledge with regard to 'The Electrification of the Atmosphere,' as set forth in the recent publications of Chree, Elster, Geitel and Schuster. The author thinks that there are good grounds for believing that the twentieth century will number among its triumphs a complete electrical survey of the atmosphere. He regards the question as to the relation between the magnetic elements and the atmospheric electric currents as the coming one.

Mr. Littlehales gives an abstract of his recent researches with respect to the establishment of 'Secular Variation Expressions of the Magnetic Inclination.' This investigation is preparatory to a future article which will give the secular change in the direction of a freely suspended magnetic needle at each of twenty-two stations distributed over the globe.

Dr. Bauer, in the next article, 'A Remarkable Law,' presents formulæ giving the diurnal range of the magnetic declination and inclination as simple functions of the magnetic inclination. The formulæ were first found empirically and then deduced theoretically by assuming that the component of the deflecting force producing the angular deflection of the needle from its mean position is inversely proportional to the force exerted on the needle by the earth's permanent magnetism. The formulæ would imply that the lines of equal magnetic inclination represent closely the lines of equal diurnal range. The author finds that the same functions hold with regard to some of the secular and distribution phenomena of the earth's magnetism.

In 'Letters to Editor' is a communication from Professor Hellman regarding Stevins's 'ΛΙΜΕΝΥΡΕΤΙΚΗ;' another from Dr. van Bemmelen discussing the non-cylic phenomena of the diurnal variations, and a third from Drs. von Rijckevorsel and van Bemmelen giving the results of their magnetic observations on the Rigi, made in 1895 and 1896.

Abstracts, Reviews, List of Publications and Notes close the number.

SCIENCE

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FRIDAY, AUGUST 6, 1897.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE meetings of the American Association for the Advancement of Science at Detroit next week and of the British Association at Toronto on the following week are events of more than ordinary moment. The visit of the British Association to Montreal in 1884 gave a considerable impulse to science in America. The meeting of our own Association in that year was attended by three hundred British men of science, the total attendance, 1249, being the largest in its history. In the thirteen years that have since elapsed science in America has made a great forward movement. The scientific research accomplished at our universities now surpasses that of the British universities; the work done under our government is greater than in any other country; our scientific journals have doubled in number and increased in influence. If our Association has scarcely kept abreast of the great progress of science, this is the proper time to give it a due place in the scientific economy.

It is certainly the duty as well as the privilege of every American man of science to try to attend the meetings at Detroit and

Toronto. The places and times have been arranged so that this can be done conveniently. The scientific programs and social arrangements for both meetings promise ample reward for those who are able to be present. We must not fail to give British men of science a cordial welcome, and we have much to learn from their meeting. Our own Association deserves support. Every motive of public spirit and self-interest should lead us to make the meeting at Detroit worthy of the present position of science in America and a stepping-stone in its progress.

We do not at all sympathize with the idea sometimes expressed that National Associations for the Advancement of Science have outlived their usefulness. There is nothing more typical of modern social conditions than combinations and trade-unions. Human development depends less than formerly on natural selection of the individual and more on competition between groups. It will fare ill with men of science if they cannot unite to maintain and forward their common interests. With them not only selfish instincts of self-preservation are concerned, but also moral sentiments, for they believe that the interests of science are in large measure conterminous with the interests of civilization.

The objects of the American Association for the Advancement of Science "by periodical and migratory meetings, to promote intercourse between those who are cultivating science in different parts of America, to give a stronger and more general impulse and more systematic direction to scientific research, and to procure for the labors of scientific men increased facilities and a wider usefulness," are as valid and as important now as they were when the constitution was adopted fifty years ago. Indeed, as the magnitude of the interests increases, the need of caring for them becomes more urgent. With the growth of specialization and the scattering of men of science over the whole area of America, the need of cultivating intercourse between them becomes more pressing. The greater popular interest in science requires direction into proper channels. As science grows, it needs more workers and more money. The workers must be secured from students at school and college, the money from private gifts and from the State. The magnitude of scientific work is now such that in many cases it can only be accomplished by united effort continuing for years. Witness what the Royal Society has accomplished in inaugurating international cooperation in the cataloguing of scientific literature; the Zoologische Gesellschaft in the publication of 'Das Tierreich,' the British Association in the work of its committees. The American Association should not only maintain its present position, but should make itself a still more important factor in the advancement of science.

It must not be forgotten that as the environment alters, the organization that will survive must accommodate itself to the new conditions. Science in America is very different to-day from what it was fifty years ago. There is reason to doubt whether the Association has in like measure enlarged its range and increased the nicety of its adjustments. Methods suitable to a small gath-

ering from a limited area, representing sciences undeveloped and undifferentiated, may have been outgrown.

It seems evident that the permanent organization of the Association, both at and between the meetings, should be strengthened. Even a congress or legislature whose professed object it is to legislate must leave the real work to committees. The democratic character of a scientific association is sufficiently guarded by the election of representatives who will carefully consider and decide questions of policy. It is, indeed, possible that the present Council of the Association is too cumbersome. Then there is need of a strong interim organization, and we think that this should be extended to the sections. A permanent secretary and a committee or council for each section would give greater continuity and efficiency.

It is not possible to divide the field of science into nine sections, each homogeneous and independent of the others. Section A is for mathematics and astronomy, but there are portions of astronomy less closely related to mathematics than are portions of physics, of chemistry and of engineering. The International Congress of Mathematicians meeting this summer will be divided into six sections. On the other hand, there are subjects that would naturally fall in or between two or more sections, and others that would include several sections. Modern science is marked by great specialization, and this itself gives rise to nearly all possible combinations of the sciences and leads us back to the ultimate unity of science.

The solution for the Association seems to be that there should be, on the one hand, sub-sections—consisting perhaps of societies with separate organizations—for the reading and discussion of papers, important only for a limited group of students; and, on the other hand, joint meetings of two or more sections or of the whole Association for the consideration of subjects of general scientific interest, and to promote the organization and advancement of science as a whole.

For example, during the past year two of the most important contributions made to the theory of evolution for a long time have come from America. These are that individual variations set the line of organic evolution and that variations and heredity, respectively, have been confused by attributing the former to the environment and the latter to the organism. These advances have been proposed by a psychologist, a zoologist, a botanist and a geologist. They are not yet acknowledged nor understood by men of science abroad, and would have been a suitable subject for a session of the whole or a large part of the Association.

Taking next an example of desirable specialization, it may be noted that there meet during the Christmas holidays four societies for which there are no places in the Association; these are the American Physiological Society, The Association of American Anatomists, The Society of Morphologists and The American Psychological Association. Each of these societies is composed exclusively of those devoted to research in the sciences represented. At the last meetings an aggregate of over 100 papers was presented, representing one-half

as many papers as are annually read before the Association. It is evident that the Association cannot represent the whole of American science while such important developments are ignored. Only a small percentage of the members of these societies are fellows of the Association.

Indeed, we must admit that a large proportion of those most actively engaged in advancing science in America do not attend the annual meetings, and many are not even fellows of the Association. We may appeal to the public spirit of these men of science and probably with success. It would, however, be far better to make the meetings so fruitful that each would like to attend, and, if possible, to give those unable to attend some return for membership in addition to the annual volume of proceedings. Election as fellow should be an honor that no one would decline. The fellows should not be elected exclusively from the members, but those who are doing the most for the advancement of science in America should be the fellows of the Association. It would probably be desirable to limit the number of fellows to one thousand and to fill vacancies each year as they occur. As soon as the fellows of the Association were acknowledged to be the thousand leading men of science in America, election would be an honor only less in degree than election to membership in the National Academy of Sciences. In this case an added interest would be given to the annual meetings. With the National Academy as the 'upper house' and the American Association the 'lower house' of American science a great improvement in organization would be effected. It would be a natural courtesy for the Academy to elect its members from the Association and for the Association to elect its President from the Academy. We may view with great satisfaction the fact that the President of the National Academy is this year President of the Association.

In conclusion, we may once more urge the importance of attending the Detroit meeting of the Association and of proceeding thence to Toronto. Those taking part in these meetings will receive a stimulus in scientific activity, and by making the meetings noteworthy will contribute greatly to the advancement of science in America. Questions affecting the future of the Association will be considered at Detroit, and arrangements will be made for adequately celebrating the fiftieth anniversary of the Association. There is no doubt but that during the next fifty years science will be the leading factor in the progress of the world, and probably more depends on America than on any other country. The American Association for the Advancement of Science has great opportunities and great responsibilities.

THE INTERNATIONAL CATALOGUE OF SCIENTIFIC LITERATURE.

The International Bibliographical Conference held in London, July 14–17, 1896, was the most important step ever taken toward international cooperation in scientific and bibliographical work. This account of the meeting is derived, unfortunately, not from personal knowledge, as I was not present. I have had, to aid me in its preparation, the two official publications

of the Conference, the so-called Acta and a verbatim report of the proceedings issued by the Royal Society, as well as information derived from the United States delegates, and the official correspondence of the Smithsonian Institution.

Before taking up the Conference itself, it might be well to consider briefly the history of the movement toward an international catalogue of scientific works. It is no small satisfaction to us that the incentive to this work came from America. Professor Joseph Henry first conceived a plan for a scientific bibliography in 1854, and when he sought the cooperation of the British Association for the Advancement of Science, the subject was referred to a committee consisting of Fellows of the Royal Society who approved the suggestion. Ten years later the Royal Society aided by government grant undertook the publication of a catalogue of scientific papers since 1800, 11 volumes of which have now appeared. In the preface to the first volume we read: "The present undertaking may be said to have originated in a communication from Dr. Joseph Henry, Secretary of the Smithsonian Institution, to the meeting of the British Association at Glasgow in 1855, suggesting the formation of a catalogue of philosophical memoirs."*

*"A communication from Professor Henry, of Washington, having been read, containing a proposal for the publication of a Catalogue of Philosophical Memoirs scattered throughout the Transactions of Societies in Europe and America, with the offer of cooperation on the part of the Smithsonian Institution, to the extent of preparing and publishing, in accordance with the general plan which might be adopted by the British Association, a Catalogue of all the American Memoirs on Physical Science, the Committee approve of the suggestion and recommend that Mr. Cayley, Mr. Grant and Professor Stokes, be appointed a committee to consider the best system of arrangement, and to report thereon to the Council." (Rept. of the 25th meeting of the British Association for the Advancement of Science, held at Glasgow in September, 1855, p. LXVI.)

"This index of all the physical papers in the transactions of learned societies and in the scientific periodicals resulted from a letter addressed to the British Association in 1855, by the Secretary of this Institution, setting forth the advantages to science of such a work. The matter was referred to a committee of the Association, reported favorably upon, and recommended for execution to the Royal Society." (Smithsonian Report for 1867, p. 58.)

In March, 1894, the Royal Society issued a circular to learned societies throughout the world, which called attention to the fact that the catalogue of scientific papers was limited to periodical scientific literature, taking no account of monographs and independent books and that titles were arranged solely by authors' names. Further, that the catalogue was confessedly incomplete. The development of scientific literature had been so great and the need for a subject catalogue so apparent that the President and Council of the Royal Society appointed a committee "to inquire into and report upon the feasibility of such a Catalogue being compiled through International Cooperation." A circular embodying these statements was sent to learned societies in correspondence with the Royal Society and elicited very general and favorable response. At the same time the following letter was addressed to the Smithsonian Institution:

"MY DEAR PROFESSOR LANGLEY: The Smithsonian Institution is, on historical grounds, so closely connected with the efforts of the Royal Society in cataloguing scientific papers that I am directed to add to the circular letter herewith sent, a few words expressing the hope of the Committee of the Royal Society which has the matter in hand that they may have, in a special way, the assistance of your valuable body in coming to a decision on so important a question. Believe me, yours very truly,

[Signed] M. FOSTER,
Sec. R. S."

The matter occasioned much discussion both in this country and abroad. The circular was published in full in SCIENCE,* and there appeared in the same number a report of a committee of the Faculty of Harvard University to the University Council expressing its sympathy, making some suggestions and recommending that the corporation of Harvard University contribute a certain sum toward carrying out the enterprise.

Professor Henry A. Todd,† of Columbia University, made some suggestions in regard to a card catalogue of scientific literature with annotations. He proposed that the Smithsonian Institution should assume the leaderehip in America, and that publishers should be asked to coöperate.

Mr. W J McGee‡ discussed certain of the practical sides of the question, and announced that the Geological Society of America had concurred in the report of the Harvard University Council. The Franklin Institute, of Philadelphia, also expressed itself favorably.§

Doctor G. Brown Goode|| laid down a most careful plan of operations. He held that the catalogue should be international in name and scope, should be exhaustive within its own limits, and that it should be published in book form, as a card catalogue would, in his opinion, be too bulky. He also suggested a broad classification of science which, it may be said by way of anticipation, included economic science, mechanical science and engineering, philology and institutional history, all of which were excluded by the Conference.

Numerous other bodies responded favorably and many articles were written on the subject.

The next step in the matter was taken when the Royal Society issued a circular in August, 1895, containing a report made to the President and Council in July, 1895, by the Special Committee. This circular stated that more than one hundred replies had been made to the original circular and that in no single instance was any doubt expressed as to the value of the work proposed. The cordial letter of the Secretary of the Smithsonian Institution and the replies received from the United States were especially dwelt upon, and the holding of an international conference as a first step in the matter was recommended by many Societies.

Accordingly, on August 15, 1895, the Secretary of the Royal Society addressed a letter to the Marquis of Salisbury, Premier and H. M. Minister for Foreign Affairs, in which he reviewed the matter and pointed out the advisability of a conference in London looking to international cooperation. He suggested that such a conference be called by the British government and that certain governments named should be invited.

In pursuance of this suggestion, the Department of State at Washington (and it may be assumed that a similar course was followed with regard to other countries) received from the British Ambassador, in October, 1895, a copy of the letter of the Royal Society, with the expression, on the part of Lord Salisbury, of the hope that the United States government would be represented at the conference. This matter was referred by the Secretary of State to the Secretary of the Smithsonian Institution, who recommended that the United States government should take part and suggested that Dr. John S. Billings and Professor Simon Newcomb should serve as delegates for the United States, a recommen-

* N. S., Vol. I., pp. 182–184.

† SCIENCE, N. S., Vol. I., p. 297.

‡ SCIENCE, N. S., Vol. I., p. 353.

§ *The Library Journal*, Vol. XX., p. 172.

|| SCIENCE, N. S., Vol. I., p. 433 'Ideal Index of Scientific Literature.'

dation which was adopted. The conference was formally held at London, July 14–17, 1896.

With this brief introduction I will now give: (1) a list of the governments represented by delegates; (2) a condensed account of such portions of the debates as would seem to be of especial bibliographical and scientific interest; (3) for the sake of clearness, a recapitulation of all of the resolutions agreed to with the exception of such as related purely to matters of detail concerning the holding of meetings, and (4) the report of the United States delegates, together with official documents relating thereto.

The following delegates attended:

Austria.—Prof. Ernst Mach (Mitglied der Kaiserlichen Akademie der Wissenschaften, Vienna). Prof. Edmund Weiss (Mitglied der Kaiserlichen Akademie der Wissenschaften, Vienna).

Belgium.—M. H. La Fontaine (Membre de l'Institut International de Bibliographie, Brussels). M. Paul Otlet (Membre de l'Institut International de Bibliographie). M. de Wulf (Membre de l'Institut International de Bibliographie).

Denmark.—Prof. Christiansen (Universitet, Copenhagen).

France.—Prof. G. Darboux (Membre de l' Institut de France). Dr. J. Deniker (Bibliothécaire, Muséum d' Histoire Naturelle, Paris).

Germany.—Prof. Walther Dyck (Mitglied der K. Bay. Akad. der Wiss. zu München). Prof. Dziatzko (Direktor der Universitäts Bibliothek, Göttingen). Prof. Van't Hoff (Mitglied der K. P. Akademie der Wissenchaften zu Berlin). Prof. Möbius (Mitglied der K. P. Akademie der Wissenschaften zu Berlin). Prof. Schwalbe (Direktor, Berlin).

Greece.—M. Avierinos M. Averoff (Greek Consul at Edinburgh).

Hungary.—Prof. August Heller (Librarian, Ungarische Akademie, Buda-Pesth). Dr. Theodore Duka (Membre Academie Hongroise des Sciences, Buda-Pesth).

Italy.—General Annibale Ferrero (Italian Ambassador in London).

Japan.—Assistant Prof. Hantaro Nagaoka (University, Tokio). Assistant Professor Gakutaro Osawa (Medical College, Tokio).

Mexico.—Senor Don Francisco del Paso Y Troncoso.

Netherlands.—Prof. D. J. Korteweg (Universiteit, Amsterdam).

Norway.—Dr. Jorgen Brunchörst (Secretary, Bergen Museum).

Sweden.—Dr. E. W. Dahlgren (Librarian, Kongl, Svenska Vetenskaps Akademie, Stockholm).

Switzerland.—M. C. D. Bourcart (Swiss Minister in London). Prof. Dr. F. A. Forel (President du Comité Central de la Société Helvétique des Sciences Naturelles).

United Kingdom.—Representing the government: Right Hon. Sir John E. Gorst, Q. C., M. P. (Vice-President of the Committee of Council on Education). Representing the Royal Society of London: Prof. Michael Foster (Sec. R. S.). Prof. H. E. Armstrong, F. R. S. Mr. J. Norman Lockyer, C. B., F. R. S. Dr. Ludwig Mond, F. R. S. Prof. A. W. Rücker, F. R. S.

United States.—Dr. John S. Billings (U. S. Army). Prof. Simon Newcomb, For. Mem. R. S. (U. S. Nautical Almanac Office).

Canada.—The Hon. Sir Donald A. Smith, G.C.M.G. (High Commissioner for Canada).

Cape Colony.—Roland Trimen, Esq., F.R.S. Dr. David Gill, C.B., F.R.S.

India.—Lieut.-General Richard Strachey, R.E., F.R.S.

Natal.—Walter Peace, Esq., C.M.G. (the Agent-General for Natal).

New South Wales.—Prof. Liversidge, F.R.S.

New Zealand.—The Hon. W. P. Reeves (Agent-General for New Zealand).

Queensland.—Chas. S. Dicken, Esq., C.M.G. (Acting Agent-General for Queensland).

The verbatim report of the debates, which accompanied the introduction of the resolutions, is much too voluminous to give even in abstract, but it would seem worth while at least to epitomize a few of the more salient points in the discussion which took place.

The attitude of the Royal Society toward the whole subject was sketched at the opening of the meeting by Professor Armstrong. The Society, he said, had felt for a number of years that in publishing a catalogue of scientific papers "it was not doing nearly enough to supply the needs of scientific workers; that the production of a catalogue arranged only according to the authors' names was altogether insufficient, and that it was essential that much more should be done, and that work should be

done much more quickly. * * * The great object before us is to produce a catalogue available for use by scientific investigators throughout the world. It is not a mere bibliographical work that we are seeking to perfect."

An interesting discussion took place on the motion of Professor Michael Foster, "that each delegate should have a vote in the deciding of questions before the Conference." Professor Simon Newcomb stated that it was not inappropriate that he should second the resolution, inasmuch as the United States would apparently be among the nations placed at the greatest disadvantage by this method of voting. Professor G. Darboux, a member of the Institute of France, representing the French government, said that he had sought instructions upon this subject, but had not received any; that in congresses of this sort votes were usually taken by nations and that if the other method was to have prevailed it should have been made known, so that more delegates could have been sent. General Ferrero, the Italian Ambassador at London, representing Italy, agreed that the observations of Professor Darboux were most important. He added, however, that with regard to questions which really are matters of science pure and simple it was the opinion of the delegates, not of nations, which was desired; while questions which were without the realm of science could readily be left to the governments to settle. In the question of classification, for example, there was no question of national interest; it was a question of science pure and simple.

Professor Möbius, representing Germany, said that the German delegates were sent by the German government or by learned societies to assist in the discussions, and to represent either the government or societies in order that they might determine in what manner they should participate in the work. He held, therefore, that they should take part as individuals, which was agreed to by Professor Edmund Weiss, representing Austria.

Professor Darboux accepted this explanation, remarking that the matter was cleared up in his mind that the meeting was not a diplomatic conference, but a congress of scholars charged to examine into the best methods of accomplishing a certain proposition, and that the final questions of finance and participation were to be referred to the respective governments. The motion was then unanimously agreed to.

Professor Armstrong moved "that it is desirable to compile and publish, by means of some international organization, a complete catalogue of scientific literature arranged according both to authors' names and to subject-matter." This was adopted, with the last clause reversed, to read "both to subject-matter and to authors' names," in accordance with the suggestion of Professor Forel, representing Switzerland. M. Otlet, one of the Belgian representatives, took the introduction of this resolution as the occasion for the presentation of a note on behalf of the Belgian delegates. This note was in the nature of a discussion of the entire subject of international bibliographical work, with special reference to the establishment of an office at Brussels some years previous. The introduction of this note occasioned some discussion with regard to the decimal system of classification. Opinions against its practicability were expressed by Professor Schwalbe, of Germany; Professor Heller, of Hungary; Professor Dziatzako, of Germany, and Professor Darboux. The discussion, however, was brought to a close by the Italian representative calling attention to the fact that it did not bear directly on the resolution before the Congress.

The next resolution which occasioned

discussion read as follows: "That the administration of such a catalogue be entrusted to a representative body hereinafter called the International Council, the members of which shall be chosen as hereinafter provided by the several countries (hereinafter spoken of as the constituent countries) who shall declare their adhesion to the project."

Professor Korteweg, representing Netherlands, proposed an amendment, which was, in substance, that the preparation of the subject catalogue should be entrusted to an international commission representing the different branches of science and that this commission should nominate the International Council. He argued that different branches of science had different needs; that under this proposal it is possible that certain branches of science would not be represented at all, or at best very unequally. Professor Armstrong suggested that it would be well to settle the question in brief, leaving the further details until afterwards. Lieutenant-General Strachey, representing India, pointed out certain other difficulties in the wording of this resolution. Dr. J. S. Billings, of the United States of America, stated that the point raised by Professor Korteweg was so important that he should prefer to see it written down and be able to consider it. Professor Korteweg then withdrew his amendment. The form suggested by Dr. Billings was objected to by Professor Foster, on the ground that it did not provide that representatives of the several countries should be on this Council, to which Dr. Billings replied: "We are not trying so much to get representation of the countries in the first place. It would be a representation of the different branches of science. The countries come in as secondary to the sciences in this representative body." After some further discussion, the resolution, as amended by Dr. Billings, was adopted.

The next resolution read was: "That the final editing and the publication of the catalogue be entrusted to an organization hereinafter called the Central International Bureau, under the direction of the International Council." This resolution, Professor Armstrong explained, would only pledge the Conference to the organization of a central office and in no way preclude the establishment of branch offices. The discussion of this resolution, in connection with the following one, brought out the question from Professor Schwalbe as to what should be done to catalogue the literature of those countries which did not contribute or failed to adhere to the scheme; to which Professor Armstrong replied that in this event he thought the central office should carry out the work. Professor Dyck, representing Germany, thought that there should be a central office, but he raised the question as to whether the subordinate councils should not be considered by sciences instead of by countries. Professor Forel pronounced most emphatically for the arrangement by nationalities. M. Otlet, representing Belgium, was strongly in favor of a division into the sciences instead of by nationalities. He argued, first, that it would be very difficult for the smaller countries to organize a commission embracing all the sciences, and, secondly, that the various sciences were already so well organized, through national and international societies, that if the matter were arranged in this way these organizations would prove powerful auxiliaries. M. Darboux was strongly in favor of an arrangement by nations, pointing out that if the matter were left to some special organizations great difficulties would arise, as the limits between the sciences were hardly decided; "if, for example," he said, "you separate physics and chemistry you run the risk of entirely sacrificing the region intermediate between the two sciences, which is,

moreover, precisely the one in which the most interesting discoveries are being made." Professor Schwalbe gave as a further reason for adhering to nations that it would be easier for a national commission to get the material and, moreover, that in countries in which different languages were employed it would be easier to arrange for classifying the material in that way. The resolution was unanimously agreed to.

The next resolution proposed read as follows: "That any constituent country which shall declare its willingness to undertake the task shall be entrusted with the duty of collecting, provisionally classifying, and transmitting to the Central Office, in accordance with the rules laid down by the International Council, all the entries belonging to the scientific literature of that country, the work of the Central Bureau being in such cases limited to revising and incorporating into the catalogue the entries so received."

Dr. John S. Billings moved an amendment to have the word 'constituent' stricken out and have it read 'any country.'

Dr. Ludwig Mond proposed that the words "the work of the Central Bureau being, in such cases, limited to revising and incorporating into the catalogue the entries so received" be omitted. This motion, as amended, was unanimously agreed to.

The next resolution was: "That, in the classification according to subject-matter, regard shall be had not only to the title (of a paper or book), but also to the nature of the contents." Professor Armstrong explained that this meant that papers would have to be read and studied in order that proper indexes might be prepared. He said, further, that it was his belief that in the future it would be necessary to insist that the author of every paper supply with his paper the material for a subject-index, which, of course, could be revised at the headquarters and subsequently at the Central Office. Dr. Billings moved that the word 'indexing' be substituted for 'classification,' which word he thought had been used wrongly. M. Deniker, representing France, pointed out that, while it was a comparatively simple matter to furnish titles, it was extremely difficult to analyze the contents. He asserted that a single article on zoology describing new species might require two hundred cards. M. Darboux seconded this observation. It is very necessary to zoology, he said, to know whether families or species were to be recorded. If the latter the number of cards would reach immense proportions, and he thought the success of the catalogue depended upon the solution of this question.

The next resolution was: "That the catalogue shall comprise all published original contributions to science, as hereinafter defined, whether appearing in periodicals or in the publications of societies, or as independent pamphlets, memoirs or books." Professor Armstrong pointed out that the object of this resolution was to include in the catalogue of the future all original scientific literature. He stated that in the past it had been the habit of the Royal Society to take note only of periodicals and of the publications of societies, so that the whole of Darwin's work which had not appeared in the publications of a society had been omitted, which was obviously absurd. Professor Newcomb objected to the words 'to science as hereinafter defined,' and suggested, 'to the branches of science hereinafter mentioned,' which suggestion was accepted. Professor Dziatzko pointed out a difficulty. Periodicals, he said, can be procured through exchange, but the matter of books is a much more serious problem, as in the larger countries it would be difficult to get all the titles of books, not to speak of copies of the books themselves; in England, the United States and France this matter

could be arranged through the copyright, but in Germany the copyright had been left to the different states of the Empire and the regulations were different. In Saxony, which included the great publishing town of Leipzig, copies of books were not required to be furnished, and the same difficulty existed in Switzerland. Professor Schwalbe thought that absolute completeness would probably be impossible, mentioning by the way that even the daily newspapers occasionally contain articles of high value which would have to be considered. Professor Mach pointed out that in Austria it was compulsory to register and deposit books, and he expressed the hope that if the Congress came to a successful issue the various governments would enact laws making the deposit of books compulsory. Professor Korteweg suggested that one difficulty would be to make the proper distinction between original works and those which had only a pedagogical value. The elementary book must be omitted, yet there were among such books many that deserved a place. At all events, he thought it desirable to state the principle that pedagogical books on popular science should be excluded. Professor Newcomb thought that the necessary omissions would not materially detract from the value of the catalogue. "Naturally," he said, "every author, if he knows that this is the only way of making his work known, will send a copy to the Bureau, or take some means of making the Bureau aware of his work." Professor Armstrong thought that there would be no difficulty, because the proposed catalogue would serve as the best possible advertisement for the books. This resolution was unanimously agreed to.

The next resolution was a most important one, being designed to bring out the distinction between pure and applied science. As introduced it reads as follows: "That a contribution to science for the purposes of the catalogue be considered to mean a contribution to any of the following sciences: mathematics, astronomy, physics, chemistry, geology, zoology, botany, physiology and anthropology, to the exclusion of what are sometimes called the applied sciences, the limits of the several sciences to be determined hereafter." Professor Schwalbe raised the question whether geography was to be considered one of the natural sciences. In Germany, he said, it was regarded not simply as an auxiliary to natural science, but as a science which of itself had relations to the whole series of natural phenomena, being related to anthropology and astronomy as well as to land surveys. He thought that geography was as much a science as chemistry or physics, and that even anthropology belonged to geography, except that portion of it which was related to anatomy. He was himself of the opinion that anthropology and geography had best be treated together. Professor Heller proposed, as a title, the 'physics of the earth,' stating that geography, meteorology and all sciences which had to do with the knowledge of the earth could be included under this title, excepting physics and astronomy. Mineralogy, he thought, could be treated as a separate science, while geography appeared to be only a portion of the science of the physics of the earth. Professor Christiansen, of Denmark, thought that it would be very difficult to define the different sciences, and that it would be best to take simply mathematics, astronomy, chemistry and botany. Professor Armstrong called attention to the fact that the question under discussion really was whether applied science was to be included. Professor Forel suggested that the phrase be simply 'physical and natural sciences, mathematics,' etc., which was agreed to by Professor Möbius, who remarked that historical studies would have to be omitted. Dr. Billings suggested

that the resolution should run: "mathematics, astronomy, physics, chemistry, geology and the biological sciences, including zoology, botany, morphology, physiology, anthropology, ethnology," etc. Dr. Billings did not think the term 'applied science' clear. In a sense astronomy is applied mathematics. He thought that some phraseology should be employed which indicates the application of sciences to professional and commercial purposes. He also called attention to statistics, which might be considered from a scientific point of view, and thought it well that the broader term biology should be introduced, instead of physiology or anthropology. Professor Möbius, after some further discussion of this resolution, pointed out that the term biology did not have the broad significance in Germany which Dr. Billings ascribed to it. The discussion of this resolution was adjourned for the day.

When the Conference met on the following day, July 15th, the mover of the resolution concerning the scope of the catalogue withdrew it by permission for the purpose of amendment. The discussion of this subject, which is really of much significance to scientific men, continued, and it was apparent that no conclusion could be reached. There seemed to be a tendency to use the words natural and physical sciences, thus leaving the whole matter indefinite. This Dr. Billings very strongly opposed on the ground that the statement as to the general scope of the catalogue should be in such form as to be perfectly clear to all scientific men. But it was evident that the question could not yet be settled, and it was finally decided to refer the terms of the resolution to a committee consisting of Professor Armstrong, Dr. Billings, Professors Möbius, Korteweg and Schwalbe.

The next matter that was of interest was a resolution which read: "That in judging whether a publication is to be considered as a contribution to science, suitable for entry in the catalogue, regard shall be had to its contents, irrespective of the channel through which it is published." It is interesting to note that there was no dissent from this proposition, and that the importance of it was emphasized by the German delegates, several of whom pointed out the fact that trade journals, as, for instance, that devoted to the beet sugar industry, or even the *Allgemeine Zeitung*, often contain scientific articles of great value.

The next resolution, which was one of great importance, read: "That the double system of authors' names and subject-matter being always maintained, the Central Bureau shall issue the catalogue in the form of 'slips or cards,' the details of the cards to be hereafter determined and the issue to take place as promptly as possible. Cards corresponding to any one or more of the branches of science, or to sections of such branches, shall be supplied separately upon such demand." Dr. Ludwig Mond thought that the issuing of cards should be at the discretion of the International Council. Dr. Billings preferred that they should be at the discretion of the Central Bureau. He pointed out that it was a purely commercial detail, and that its advisability depended upon the number of subscriptions received in advance. He hardly thought that a double system was necessary in case of the cards. There was a lengthy discussion over various forms of amendment, that of Dr. Billings being finally carried by the rather close vote of 18 to 14.

The next resolution related to the issue of a catalogue in book form and this, too, being modified, was passed, as follows: "That the Central Bureau shall also issue the catalogue in book form from time to time, the titles being classified according to the rules to be hereafter determined; that the issue in the book form

shall be in parts corresponding to the several branches of science, the several parts being supplied separately, at the discretion and under the direction of the Central Bureau."

The President of the Conference next invited expressions of opinion as to where the Central Bureau should be situated. After a brief address, in which he referred to the fact that the International Bureau of Weights and Measures was established at Paris and the International Bureau of Geodesy at Potsdam, General Ferrero, representing Italy, proposed that the Central Bureau should be established at London. M. Darboux stated, on behalf of the French delegates, that they had been charged by their country to make the same proposition. Professor Möbius made a similar statement on behalf of the German delegates, and Professor Heller for Hungary, Professor Weiss for Austria, Professor Newcomb for the United States; and the representatives of Belgium, Switzerland, Denmark, Sweden and Netherlands agreeing, the resolution to have London as a central office was carried by acclamation. Professor Foster, Secretary of the Royal Society, acknowledged the extremely sympathetic manner in which this resolution had been proposed and carried.

The President of the Conference expressed his thanks on behalf of the British government for the unanimous action of the Conference, assuring them that nothing would be wanting in his country in the endeavor to make this international work a success.

He then invited an expression of opinion as to the constitution of the Council. Professor Foster remarked that there were several ways of electing a council. One was that there should be an appointment of international committees corresponding with the various branches of science and that these international committees should nominate the council. Another plan was that each nation should nominate its members for the council directly. The German delegates stated that they had been directed, by the bodies they represented, to refer back to them the choice of persons for the international bureau. Professor Schwalbe agreed to this view, asserting that the right should be reserved to each government to name the persons who would represent it in carrying on the enterprise. Dr. Duka, representing Hungary, thought that this was a matter to be referred to the respective governments. Various delegates followed this idea, suggesting a postponement of the whole subject, but Professor Newcomb pointed out that inasmuch as this Conference had decided to appoint an international council it could not adjourn without indicating in some way the steps to be taken in the formation of the council. As a tentative proposition he, therefore, proposed the following resolution: "The International Council shall consist, in the first place, of members, one of whom shall be appointed by the government of each country taking part in the preparation of the catalogue. The Council as thus formed shall have power to choose such additional members as it shall deem necessary for the efficiency of its organization." Dr. Billings noted a difficulty in the use of the word government. He said it might very well happen in the United States that the government might have nothing to do with the preparation of the catalogue; that it might come under such bodies as the National Academy of Sciences or the Smithsonian Institution, which could not be said to be the government of the United States. General Ferrero agreed with the suggestion of Dr. Billings, thinking that it might be better for the enterprise if the choice of the delegates were left to some scientific body. M. Darboux thought that

everybody would agree that the nomination should be by the government. Professor Dziatzko proposed that the Conference should appoint a provisional committee, which should enter into communication with various governments and learned societies and thus prepare for a second conference which would settle all details. General Ferrero thought that the Royal Society could itself take the place of the provisional committee suggested by Professor Newcomb, but no definite agreement was arrived at on this point, and the Conference adjourned for the day.

On Thursday, July 16th, the Conference again assembled, and the special order was the report of the committee for the purpose of considering a resolution to indicate the nature of the subjects to be admitted to the catalogue. This committee reported as follows: "That a contribution to science for the purpose of the catalogue be considered to mean a contribution to the mathematical, physical, or natural sciences, such as, for example, mathematics, astronomy, physics, chemistry, geology, mineralogy, zoology, anatomy, botany, physiology, general and experimental pathology, experimental psychology, and anthropology, to the exclusion of what are sometimes called the applied sciences, the limits of the several sciences to be determined hereafter." Professor Möbius called attention to the fact that experimental psychology was known in Germany as psycho-physics, and it was agreed to insert that word in the German text. Professor Forel and the Italian Ambassador favored the inserting of mathematical and physical geography, which was agreed to. M. Otlet suggested the insertion of paleontology, but several members insisted that this was included under zoology.

This matter, which threatened to cause considerable trouble being disposed of, the resolution of Professor Newcomb respecting the constitution of an International Council was taken up, and with the permission of the Conference his resolution was withdrawn in order that another one, which had received fuller consideration, should be admitted. Professor Foster said that he understood it to be the view of the Conference to remit the question to the Royal Society. He said that while the Society would be very proud to accept any duty which might be imposed upon them they would shrink from any executive power in connection with the matter. It had been suggested that this organizing committee of the Royal Society should report to a future meeting of the Conference, but this was objected to by several persons on the ground that when the Conference was adjourned it ceased to be, so that a future Conference was suggested. One of the longest discussions of the entire meeting now followed, but it related largely to questions of diplomacy and policy and may well be omitted here. After many amendments the resolution read: "That the Royal Society be requested to form a committee to settle the questions relating to the catalogue referred to it by the Conference, or remaining undecided at the close of the present sittings of Conference, and to report thereon to the governments concerned."

The next important matter was the introduction of the following resolution: "That whatever system of classification be ultimately adopted for the catalogue it is impossible to accept the Dewey system *en bloc.*" By way of explanation of this resolution Professor Armstrong said that he had put it in this form because the International Conference of Bibliography at Brussels had accepted the Dewey system and because it was so widely used in certain libraries. The Royal Society, while not denying the merits of the system for the librarian's use, held that it was impossible to accept it for the purpose of scientific workers. M. Otlet favored the Dewey system. Professor

Heller thought it not practicable for the purpose and favored the remission of the whole question to the committee. Professor Mach stated that as soon as he had thoroughly learned the Dewey system he had become a supporter of it and was of the opinion that some modification of the decimal system would be the best. Professor Dziatzko asserted that the Dewey system was not practicable even for large libraries. M. Otlet then spoke in favor of the Dewey system and explained the reason for its adoption by the Brussels Bibliographical Bureau.

Dr. Billings then spoke on the subject, delivering the longest address of the Conference. He said that the decimal system, known as the Dewey system, was a device for putting books in order on the shelves and a rapid method of finding them. It was simply a shorthand method of finding a book. The application of it to systematic catalogues was a different proposition. He asserted that the Dewey system is not accepted in any government library in the United States, or in any university library in the United States except Albany and Columbia, in both of which Mr. Dewey has been librarian. He said that less than 100 libraries were using the Dewey system and only about 32 the Cutter system. The Dewey system, however, was likely to grow because many young women who had been trained in Mr. Dewey's library school had taken charge of the catalogues of the smaller libraries in the United States, and the Library Bureau which had been founded by Mr. Dewey was providing a large series of useful appliances for librarians. He added: "I, for one, am disposed to award the greatest credit and admiration to Mr. Dewey, not only for the ingenuity which he has shown in this and other matters pertaining to library economy, but also for the ceaseless energy, zeal and persistence in getting the matter before the world and in having his ideas adopted as far as possible. I like to see a man believe himself, and in his own opinions, and do the best he can to put them into operation." He added, however, that the New York libraries, the Boston Public Library and the Boston Athenæum did not use the system and that it was not practicable for a systematic catalogue, even admitting its usefulness for the arrangement on the shelves.

Professor Schwalbe pointed out that even for library work the decimal system had many opponents, and he thought that some alphabetical system would be found the most practicable. Dr. Gill, representing Cape Colony, said that while the motion had brought out a good deal of condemnation of the Dewey system he had noticed that no other system had been put forward as perfect. Professor Armstrong said in reply that he did not think any other system was perfect, but that the object of the resolution was to put the matter in such shape as to leave entire freedom for action. Some considerable discussion followed without result, and Dr. Billings suggested that he would like to have a resolution of more practical value than the mere condemnation of one particular man's system. A long discussion followed on this point without result until Dr. Billings suggested that his object was to "get a declaration on the part of the conference that minute classification by means of symbols is not desirable in a catalogue. It is my opinion that no arrangement of the decimal system which you can propose, whether formed by Dewey or by others, is desirable." After some further discussion it was decided to adjourn until the next day, and on the morning of July 17th the resolution of the previous day was withdrawn and the following substituted: "The Conference, being unable to accept any of the systems of classification recently proposed, remits the study of classification to the Committee on Organization." This

resolution was seconded by Dr. Billings, who remarked that, inasmuch as one or two of his remarks of the day previous had been misunderstood by some members of the Congress, he wished distinctly to say that he did not condemn the Dewey decimal system for the classification and location of books, but he did not think it well adapted to the catalogue which it was proposed to publish. This resolution was now agreed to unanimously, the Belgian delegates desiring it to be placed on record that they abstained from voting.

Professor Deniker, representing France, now proposed: "That the catalogue according to the authors' names be in the English language, all titles to be also in their original language, unless otherwise desired by the Bureau of the country concerned." This resolution was seconded by General Ferrero, the Italian Ambassador. Professor Forel said that the question of language was one of very great importance, and he thought it should be remitted to the Committee of Organization, suggesting the following proposition: "With the questions of classification and form, the questions of the employment of four languages, German, English, French and Italian, shall be remitted to the Committee of Organization." Professor Mach, representing Austria, favored the employment of English as the only language, asserting that English is so widely spoken over the civilized world that it would be most proper to employ that language. "Every one," he said, "should respect his own nationality and his own language, but before that he should consider the universal interest of mankind." General Ferrero said that he supported the motion to use the English language because of precedent and of practicability. The official language of an international bureau should be the language of the country in which it is established; the Commission of Weights and Measures at Paris issued its publications in French, the Geodetic commission at Berlin in German. Professor Newcomb did not think it necessary to translate the titles of papers written in German, French or Italian into English. The discussion continued, many delegates taking part, until finally the following form was agreed upon: "That English be the language of the two catalogues authors' names and titles being given only in the original languages, except when this belongs to a category to be determined by the International Committee."

There was some little discussion as to whether the catalogue should begin January 1, 1900, or 1901, but the date 1900 was finally agreed to.

Professor Forel now made the following motion: "That when the organization for the catalogue is finally established it will be desirable to take in hand the publication of retrospective catalogues, carried out on the same plan, going back from century to century, as far back as the invention of printing." Dr. Billings objected to this resolution He held that it was not the business of the Conference to say what was desirable, but what was possible; that the Conference wanted to have the reputation of being a fairly sensible set of men who had not proposed to do anything which was beyond the reach of human effort properly organized. After further expressions of disapproval this resolution was withdrawn. The Conference then adjourned, with the customary votes of thanks.

Having adjourned, all the delegates presumably returned to their respective countries and made reports to their governments. The American delegates, Professor Simon Newcomb and Dr. John S. Billings, presented their report to the Secretary of State on October 15, 1896. On the following day the Secretary of State referred this report, in accordance with

the suggestion of the delegates, to the Secretary of the Smithsonian Institution, and asked for his views as to the propriety and feasibility of the work in question being undertaken by the Smithsonian Institution, and as to the probable cost, with a view to the departments taking the necessary action. A reply was forwarded to the Secretary of State and these documents transmitted by him to the Senate and House of Representatives. This was done on December 17, 1896.* Naturally enough no result has been reached. No money will be required until the year 1899–1900. But, in accordance with the terms of one of the articles, it is necessary that the countries which intend to adhere to the scheme should make their intention known before 1898. It is, therefore, most desirable that the first regular session of the 55th Congress should place itself on record as pledging the government of the United States to adhere to this plan, than which none has ever been proposed better calculated to promote the interest of science.

I cannot conclude without expressing my gratification, which I feel sure all your readers will share, in the honorable part taken by the United States in initiating this enterprise. It is but due to Dr. Billings and Professor Newcomb to recognize the great usefulness of their presence in aiding in the deliberations. Dr. Billings's long experience in bibliographical work gave his numerous recommendations great weight and they were uniformly adopted. The honor of American science demands that this country shall do its share toward bringing the proposed International Catalogue of Scientific Literature to a successful issue.

Cyrus Adler.

Smithsonian Institution,
Washington, D. C.

* The documents are appended.

APPENDIX.

The following is a selection from the resolutions agreed to :

4. That each delegate shall have a vote in deciding all questions brought before the Conference.

5. That English, French and German shall be the official languages of the Conference, but that it shall be open for any delegates to address the Conference in any other language, provided that he supplies for the proces verbal of the Conference a written translation of his remarks into one or other of the official languages.

6. General Ferrero moved that Sir John E. Gorst be the President of the Conference. The motion having been unanimously accepted,

7. Sir John Gorst nominated as Vice-Presidents: General Ferrero, Professor Darboux, Professor Mach, Professor Möbius, Professor Newcomb. It was further resolved :

8. That Professor Armstrong be the Secretary for the English Language ; that Professor Forel be the Secretary for the French language ; that Professor Dyck be the Secretary for the German language.

9. That the Secretaries, with the help of shorthand reporters, be responsible for the proces verbal of the proceedings of the Conference in their respective languages.

12. That it is desirable to compile and publish by means of some international organization a complete Catalogue of Scientific Literature, arranged according to both subject-matter and to authors' names.

13. That in preparing such a catalogue regard shall, in the first instance, be had to the requirements of scientific investigators, to the end that these may, by means of the catalogue, find out most easily what has been published concerning any particular subject of inquiry.

14. That the administration of such a catalogue be entrusted to a representative body, hereinafter called the International Council, the members of which shall be chosen as hereinafter provided.

15. That the final editing and the publication of the catalogue be entrusted to an organization, hereinafter called the Central International Bureau, under the direction of the International Council.

16. That any country which shall declare its willingness to undertake the task shall be entrusted with the duty of collecting, provisionally classifying, and transmitting to the Central Bureau, in accordance with rules laid down by the International Council, all the entries belonging to the scientific literature of that country.

17. That in indexing according to subject-matter regard shall be had, not only to the title (of a paper or book), but also to the nature of the contents.

18. That the catalogue shall comprise all published original contributions to the branches of science hereinafter mentioned, whether appearing in periodicals or in the publications of societies or as independent pamphlets, memoirs, or books.

20. That in each country the system of collecting and preparing material for the catalogue shall be subject to the approval of the International Council.

21. That in judging whether a publication is to be considered as a contribution to science suitable for entry in the catalogue, regard shall be had to its contents, irrespective of the channel through which it is published.

22. That the Central Bureau shall issue the catalogue in the form of 'slips' or 'cards,' the details of the cards to be hereafter determined, and the issue to take place as promptly as possible. Cards corresponding to any one or more branches of science, or to sections of such sciences, shall be supplied separately and under the direction of the Central Bureau.

23. That the Central Bureau shall also issue the catalogue in book form from time to time, the entries being classified according to the rules to be hereafter determined.

That the issue in the book form shall be in parts corresponding to the several branches of science, the several parts being supplied separately, at the discretion and under the direction of the Central Bureau.

24. That the Central Bureau be located in London.

The resolution was seconded by M. Darboux, supported by Messrs. Möbius, Heller, Weiss, Simon, Newcomb, Otlet, Duka, Bourcart, Dahlgreen and Korteweg, and accepted by acclamation.

25. That a contribution to science for the purpose of the catalogue be considered to mean a contribution to the mathematical, physical, or natural sciences, such as, for example, mathematics, astronomy, physics, chemistry, mineralogy, geology, botany, mathematical and physical geography, zoology, anatomy, physiology, general and experimental pathology, experimental psychology and anthropology, to the exclusion of what are sometimes called the applied sciences—the limits of the several sciences to be determined hereafter.

26. That the Royal Society be requested to form a committee to study all questions relating to the catalogue referred to it by the Conference, or remaining undecided at the close of the present sittings of the Conference, and report thereon to the governments concerned.

27. Since it is probable that, if organizations be established in accordance with Resolution 16, the Guarantee Fund required for the Central Bureau can be supplied by voluntary subscriptions in various countries, this Conference does not think it necessary at present to appeal to any of the governments represented at the Conference for financial aid for the Central Bureau.

28. The Conference being unable to accept any of the systems of classification recently proposed, remits the study of classifications to the Committee of Organization.

29. That English be the language of the two catalogues, authors' names and titles being given only in the original languages except when these belong to a category to be determined by the International Council.

30. That it be left to the Committee (of the Royal Society) to suggest such details as will render the catalogue of the greatest possible use to those unfamiliar with English.

31. That it is desirable that the Royal Society should be informed, at a date not later than January 1, 1898, what steps (if any) are being taken, or are likely to be taken, in the countries whose governments are represented at the Conference, towards establishing organizations for the purpose of securing the end had in view in Resolution 16.

32. That the delegates in reporting to their respective governments the proceedings of the Conference should call immediate attention to Resolutions 16 and 31.

33. That January 1, 1900, be fixed as the date of the beginning of the catalogue.

34. That the Royal Society be requested to undertake the editing, publication and distribution of a verbatim report of the Proceedings of the Conference.

35. That the proces verbal of the Conference be signed by the President and Secretaries.

Letter from the Secretary of State, transmitting with the draft of a proposed joint resolution and inclosures from the Secretary of the Smithsonian Institution, recommendations for an appropriation to enable the United States to participate in the work of making an International Catalogue of Scientific Works.

DEPARTMENT OF STATE,
Washington, December 17, 1896.

SIR: I have the honor to transmit, herewith, the report of Professor Simon Newcomb and Dr. John S. Billings, delegates from this country to the International Conference on a Catalogue of Scientific Literature, held in London in July last by request of the Royal Society, and having for its object an international agreement as to the steps necessary to the preparation, editing and continuous publication of the current scientific literature of all countries.

It will be seen that by the thirty-second resolution formulated by the Conference the delegates were especially requested to bring the following two resolu-

tions to the attention to their respective governments:

16. That any country which shall declare its willingness to undertake the task shall be entrusted with the duty of collecting, provisionally classifying, and transmitting to the Central Bureau, in accordance with rules laid down by the International Council, all the entries belonging to the scientific literature of that country.

31. That it is desirable that the Royal Society should be informed, at a date not later than January 1, 1898, what steps, if any, are being taken, or are likely to be taken, in the countries whose governments are represented at the Conference, toward the establishing of organizations for the purpose of securing the end had in view in Resolution 16.

In the opinion of Professor Newcomb and Dr. Billings, it is desirable that the government of the United States should take its part in the proposed work by providing for the continuous cataloguing of scientific papers published in the United States, and they suggest the propriety and feasibility of the work being undertaken by the Smithsonian Institution.

Professor S. P. Langley, Secretary of that Institution, to whom I have submitted the report of the delegates, concurs in their view as to the great importance of a successful execution of the conclusions of the Conference, and as to the propriety of this government taking its share of the proposed work by providing for the cataloguing of scientific publications of the United States. He recognizes the propriety also of the suggestion that this government should employ the Smithsonian Institution as an agent in the matter, but points out that the work if assigned to the Smithsonian would require a person of special qualifications to immediately assist the Secretary, together with a number of trained clerical assistants, and that the salaries of these persons, and the expenses incident to the work, would require an appropriation of not less than $10,000 per annum. I enclose a copy of Professor Langley's letter on the subject.

The most efficient means for the purpose would seem to be a joint resolution of both Houses of Congress, and I have the honor to suggest the inclosed draft as embodying Professor Langley's views.

I have the honor to be, sir, your obedient servant,

RICHARD OLNEY.

HON. THOMAS B. REED,

Speaker of the House of Representatives.

WASHINGTON, D. C., *October 15, 1896.*

SIR: The undersigned having been appointed by the Honorable the Secretary of State delegates to the International Conference on a Catalogue of Scientific Literature, held in London in July last by request of the Royal Society, and having performed the duty thus devolving upon them, have the honor to submit the following report on the subject:

The object of the Conference was to reach an international agreement as to the steps necessary to the preparation, editing and continuous publication of a catalogue of the current scientific literature of all countries. The need of such a catalogue has been felt from the time that the volume of published scientific researches began to assume its present colossal proportions. About 1860 the Royal Society undertook to supply this need by the preparation of a general catalogue of scientific papers. The first volume of this work appeared in 1867. In the preface it is stated that the undertaking originated in a communication from Dr. Joseph Henry, Secretary of the Smithsonian Institution, to the meeting of the British Association at Glasgow in 1855, suggesting the formation of a catalogue of philosophical memoirs.

This work has been completed by the Royal Society up to the year 1883. In the meantime, owing to the constant increase of the volume of published researches, the task of continuing the catalogue has become so heavy that the Royal Society should no longer be expected to bear the entire burden of its continuance. Moreover, in its present form, the catalogue is arranged solely according to authors' names. In order that the work of the future should be entirely satisfactory it is necessary that the catalogue should also be arranged according to subjects.

Under these circumstances, the Royal Society last year moved the British government to make application to the governments of those countries most interested to send delegates to an international conference on the subject, to be held in London in July, 1896. At this meeting nearly all the leading countries of the world were represented. From the beginning the views were found to be substantially harmonious so far as general conclusions were concerned, and the discussion turned rather upon the form than upon the substance of the proposition submitted. The conclusions as finally formulated are embodied in the enclosed copy of the acta.

It will be seen by the thirty-second resolution the delegates were especially requested to bring the following two resolutions to the attention of their respective governments:

16. That any country which shall declare its willingness to undertake the task shall be entrusted with the duty of collecting, provisionally classifying, and transmitting to the Central Bureau, in accordance with rules laid down by the International Council, all the entries belonging to the scientific literature of that country.

31. That it is desirable that the Royal Society should be informed at a date not later than January 1, 1896 (1897),* what steps, if any, are being taken,

* The report of the Conference gives the date January 1, 1898.

or are likely to be taken, in the countries whose governments are represented at the Conference, toward establishing organizations for the purpose of securing the end had in view in Resolution 16.

Under these circumstances it seems especially desirable that the government of the United States should take its part in the proposed work by providing for the continuous cataloguing of scientific papers published in the United States. It can for this purpose call to its aid a national institution well prepared to direct and supervise the undertaking. The Smithsonian Institution, founded by private munificence for the increase and diffusion of knowledge among men and placed in trust under the government of the United States, was the original proposer of the undertaking now under consideration, and has been made the agent of the government in the direction of important scientific enterprises. We would, therefore, respectfully suggest that the Department of State communicate with the Secretary of the Smithsonian Institution upon this subject, more especially as to the propriety and feasibility of the work being undertaken by that Institution and as to the probable expense, and that when these facts are ascertained the matter will be laid before Congress with such recommendation as the Department, in its wisdom, may deem appropriate.

Very respectfully, your obedient servants,

SIMON NEWCOMB,
JOHN S. BILLINGS.

The SECRETARY OF STATE,
Department of State, Washington, D. C.

SMITHSONIAN INSTITUTION,
Washington, October 27, 1896.

SIR: I have the honor to acknowledge the receipt of your communications of the 16th and 21st instant, inclosing copies of a report of the delegates of this government to the International Conference on a Catalogue of Scientific Literature, summoned in London by the British government at the request of the Royal Society in July last, and inviting an expression of my opinion as to the propriety and feasibility of the United States taking part, through the Smithsonian Institution, in the proposed work by providing for the continuous cataloguing of scientific literature published in the United States, as suggested by the delegates, and further requesting an estimate of the probable expense attendant thereto.

I fully concur in the view of the delegates as to the great importance of a successful execution of the conclusions of the Conference, and as to the propriety of this government taking its share of the proposed work by providing for the cataloguing of the scientific publications of the United States. This opinion is strengthened by the fact that the recommendations made are due to results emanating from the International Conference, at which the United States was officially represented, and by the further considerations that the benefits to be derived from this undertaking are not only great and far-reaching for the scientific progress of America, but also of universal value, and that all the great and many of the smaller nations will take part in the work.

I recognize also the propriety of the suggestion that the government should employ the Smithsonian Institution as an agent in this matter, particularly since the Institution, as the delegates have pointed out, first suggested this subject in 1855, and since it has been from its earliest organizat on interested in scientific bibliogrophy.

I should, however, be reluctant to commit the Institution to the appearance of soliciting Congress in this matter in any case, or to the undertaking of the enterprise, however worthy, unless provision could be made for the necessary expenses of the work. After considering the subject, it seems to me that the work, if assigned to the Smithsonian Institution, would require a person of special qualifications to immediately assist the Secretary, together with a number of trained clerical assistants, and that the salaries for these persons and the expenses incident to the work would require an appropriation of not less than $10,000 per annum.

Expenditures on this appropriation would probably not need to be available before the fiscal year commencing July 1, 1899, though it would seem to be advisable that if the government is to cooperate in the proposed work there should be some earlier assurance of this.

Should the views here given meet with your approval, I venture to express the hope that the Department of State will bring this matter to the attention of the President for transmission to Congress, as was done on a previous occasion when the Institution was requested to assume the care of the international exchange of publications in behalf of the government.

I have, etc.,

S. P. LANGLEY,
Secretary.

HON. RICHARD OLNEY,
Secretary of State.

Resolved by the Senate and the House of Representatives of the United States of America in Congress assembled, That for the purpose of carrying out on the part of the United States the recommendation of the International Conference on a Catalogue of Scientific Literature, held in London in July, eighteen hundred and ninety-six, the sum of ten thousand dollars, or so much thereof as may be necessary, be, and the same is hereby, appropriated, out of any money in the Treasury not otherwise appropriated, for the

expense of clerk hire and the other expenses incident to the work of cataloguing the scientific publications of the United States, the same to be expended under the direction of the Secretary of the Smithsonian Institution.

BRITISH ASSOCIATION, TORONTO MEETING.

THE second Canadian meeting of the British Association will commence in Toronto August 18th, and will continue for eight days. Present indications are that a very large number of British visitors will be in attendance, amongst whom will be found some of the most representative men of British science. About twenty Continental savants, also of representative character, will attend.

Arrangements have been made by the Council of the British Association whereby the members of the American Association are entitled to become annual members of the British Association on the payment of a fee of $5.00. Those who are not members of the American Association can become annual members on the payment of $10.00 or associate members on payment of $5.00. Arrangements are now made whereby the application for membership can be made to one of the local Treasurers of the Association, Mr. James Bain, British Association office. For the convenience of Americans who propose to attend the Toronto meeting, a list of lodgings and apartments as well as a list of hotels has been published and copies of these may be had upon application to the local Secretaries at Toronto. American members of the British Association are entitled to travel in Canada east of Port Arthur at half the usual charge for first-class tickets, this privilege beginning on July 1st and expiring on September 30th. In order to enable the members to receive this privilege they must be provided with what is called a railway certificate, which can be had on personal application to the local officers at Toronto or to the railway officers at Montreal. The presentation of this certificate at any office will at once enable the holder of it to receive reduced railway rates. Such members also will be entitled to reduced rates for a trip over the Canadian Pacific Railway from Toronto to points in western Canada. The rate from Toronto to the Pacific coast and return varies from $61.80 to 70.30, according to the route selected. This does not include the Pullman fare, for which an extra charge will be made.

The various excursions which are arranged for will take place either during the meeting from Saturday, August 21st, to Monday, August 23d, or immediately after it, on Thursday, 26th, 27th and 28th, and will be made at reduced rates. The excursion to Muskoka, which will be for about four hundred, embracing a run of a hundred and ten miles by rail, with a sail over the Muskoka lakes, will cost $1.65. The excursion from Toronto to Niagara will cost $1.25.

The office of the British Association, will be in the University of Toronto building. All the meetings of the Association excepting those for the President's address and the two evening lectures, will be held in the lecture rooms and laboratories of the University of Toronto. The President's address is to be delivered in Massey Hall, where also will be given the two evening lectures by Professor John Milne and Professor Roberts-Austen. The free lectures on Borneo to artisans will be given by Dr. H. O. Forbes, in the Horticultural Pavilion.

According to the scheme of the local provisional program, the time of the members will be pretty fully occupied. The first General Committee meeting of the Association will take place on the afternoon of Wednesday, August 18th. The President's address will be delivered on the evening of the same day. The Sections will meet on Thursday, August 19th, and the addresses of the Presidents will be then given. In the afternoon of the same day

there will be a large garden party given at the Royal Canadian Yacht Club, Toronto Island. His Excellency, the Governor-General, and the Countess of Aberdeen will in the evening give a reception to the members in the Parliament buildings of the Province of Ontario. On Friday there will be meetings of the Sections until about three o'clock, when there will be a Convocation of the University of Toronto to confer the Honorary Degree of Doctor of Laws upon Lord Kelvin, Lord Lister, Sir John Evans and the President of the American Association, Professor Wolcott Gibbs. After Convocation is over there will be several garden parties for the members. In the evening will be the lecture of Professor Roberts-Austen, F. R. S., on 'Canada's Metals.' This will be illustrated by demonstrations of electric furnaces in the reduction and separation of the various metals. On Saturday morning the Sections will meet and adjourn early, in order that the members may take the various excursions which are arranged for from Saturday to Monday. The members will be offered a choice in these, there being four routes, one to Muskoka, the lake region of Canada, a second to Niagara Falls, a third to Hamilton and Dundas, thence to Niagara Falls, a fourth to Georgian Bay. The members of the Geological Section are to visit and examine the Niagara Gorge, under the guidance of Messrs. G. K. Gilbert, J. W. Spencer and F. B. Taylor, all of whom have given special attention to the geology of the Niagara region. Arrangements are being made whereby members of this party will have an opportunity of going up by the Gorge Railway and returning by the Niagara Falls and Victoria Park Railway or *vice versa.* These two trips will enable them to cover all the special points of interest in connection with the much debated geology of Niagara Falls.

Members of the Section for Mechanical Science will also visit Niagara to examine the Hydraulic Companies' works and the plant for the manufacture of carborundum. The various Hydraulic Power Companies have extended a special invitation to the members of the Association, and it is expected that a large number will avail themselves of the privilege accorded. It is probable that amongst the visitors on this occasion will be a large number of the most eminent electricians and engineers.

The excursionists to Muskoka will stay at the various hotels and lodging houses in the Muskoka region over Sunday. Another party will have an opportunity of visiting the many thousand islands in Georgian Bay. This group will go partly by rail to Penetang, thence by boat through Georgian Bay to Parry Sound, returning on Monday morning. On Monday the majority of the Sections will again meet. On Monday afternoon the Geological Section will examine the glacial region of Scarboro' Heights and the Don Valley, which are of special interest to students of the glacial age, the deposits there being very extensive and of great thickness. A number of garden parties are also arranged for the members during this afternoon.

In the evening Professor John Milne, F.R.S., recently of the University of Tokyo, will deliver an illustrated lecture with demonstrations on 'Earthquakes and Volcanoes.' On Tuesday morning the Sections will again meet. In the afternoon there will be a Convocation of Trinity University to confer the Honorary Degree of D.C.L. on Lord Lister, Sir John Evans and Professor Forsyth, this ceremony being followed by several garden parties. In the evening there will be a Conversazione with music and refreshments in the main building of the University of Toronto for all the members of the Association. On Wednesday the Sections will meet for their con-

cluding meeting, and in the afternoon the second and last general meeting of the Association will take place. In the evening a banquet will be given in honor of Lord Kelvin, Lord Lister and Sir John Evans, at which there will probably be in all about four hundred guests. It is proposed to reserve a number of tickets, about seventy-five, for those who may not have an opportunity of claiming one at an earlier date.

The full number of Sections will meet at Toronto. Within the last few years the number has increased from eight to ten, the increase being due to the removal of Physiology and Botany from Section D (Biology), which is now called Zoology. Section I (Physiology) only meets where there is a physiological laboratory, and consequently it will be in session at Toronto. The Presidents of the various Sections have been specially chosen for the Toronto meeting: Professor Forsyth, D.Sc., F.R.S., of the University of Cambridge, for Mathematics (Section A); Professor William Ramsay, Ph.D., F.R.S., for Section B (Chemistry); Dr. G. M. Dawson, C.M.G., F.R.S., Director of the Dominion Geological Survey for Section C (Geology); Professor L. C. Miall, F.R.S., F.L.S., for Section D (Zoology); Dr. J. Scott Keltie, Sec. R.G.S, for Section E (Geography); Professor Gonner, M.A., for Section F (Economic Science and Statistics); G. F. Deacon, M.Inst.C.E., for Section G (Mechanical Science); Sir William Turner, F.R.S., for Section H (Anthropology); Professor Michael Foster, Sec. R.S., for Section I (Physiology); Professor H. Marshall Ward, F.R.S., for Section K (Botany).

Amongst the British members who have promised to attend are the following:

Professor W. E. Ayrton, F.R.S., City and Guilds of London Institute.

Professor Henry E. Armstrong, Ph.D., LL.D., F.R.S, City and Guilds of London Institute.

E. W. Brabrook, F.S.A., London.

Colonel F. Bailey, Sec.R.Scot.G.S., F.R.G.S., Edinburgh.

Professor F. O. Bower, D.Sc., F.R.S., The University, Glasgow.

Professor W. F. Barrett, F.R.S.E., M.R.I.A., Royal College of Science, Dublin.

J. T. Bottomley, D.Sc., F.R.S., The University, Glasgow.

Professor T. Hudson Beare, M.Inst.C.E., F.R.S.E., University College, London.

Professor Francis Gibson Bailey, Heriot Watt College, Edinburgh.

Professor C. V. Boys, F.R.S., Royal College of Science, London.

The Right Hon. James Bryce, M. P., London, Eng.

Professor Rubert Boyce, M.D., University College, Liverpool.

G. F. Deacon, M.Inst.C.E., London, Eng.

Harold B. Dixon, M.A., F.R.S., F.C.S., Owens College, Manchester.

Sir John Evans, K.C.B., D.C.L., LL.D., D.Sc., Treas. R.S., F.S.A., F.L.S., F.G.S., etc., Nash Mills, Hemel Hempstead, Eng.

Professor J. A. Ewing, M.A., B.Sc., F.R.S., F.R.S E., M.Inst.C. E., University of Cambridge.

Professor A. R. Forsyth, M.A., D.Sc., F.R.S., University of Cambridge.

Professor C. Le Neve Foster, B.A., D Sc., F.R.S., F.G.S., Royal College of Science, London.

Professor G. Carey Foster, F.R.S., F.C.S., University College, London.

Professor Michael Foster, M.A., M.D., LL.D, D.C.L., Sec.R.S., F.L.S., F.C.S., University of Cambridge.

Hon. Sir. C. W. Fremantle, K.C.B., London.

Henry O. Forbes, LL.D., F.Z.S., The Museums, Liverpool.

Professor George F. Fitzgerald, D.Sc., F.R.S., Trinity College, Dublin.

Professor J. Reynolds Green, B.Sc., F.R.S., F.L.S., Professor of Botany to the Pharmaceutical Society of Great Britain.

Walter H. Gaskell, M.D., LL.D., F.R.S., Cambridge.

Professor A. G. Greenhill, M.A., F.R.S., Artillery College, Woolwich, Eng.

Professor E. C. K. Gonner, M.A., University College, Liverpool.

E. Sidney Hartland, F.S.A.,

Henry Higgs, LL.B., F.S.S.

Professor W. H. Heaton, University College, Nottingham.

Professor W. A. Herdman, F.R.S., D.Sc., F.R.S.E., University College, Liverpool.

Alfred C. Haddon, M.A., F.G.S., Cambridge.

Professor W. O. Halliburton, M.D., F.R.S., King's College, London.

A. Vernon Harcourt, D.C.D., LL.D., F.R.S., Cowley Grange, Oxford.

L. F. Vernon Harcourt, M.A., M.Ins.C.E., London, Eng.

J. Scott Keltie, LL.D., Sec. R.G.S., London.

The Right Hon. the Lord Kelvin, M.A., LL.D., D.C.L., F.R.S., F.R.S.E., University of Glasgow.

Prince Kropotkin, South Acton, London.

G. W. Lamplugh, F.G.S., Geological Survey Office, London Eng.

The Right Hon. the Lord Lister, D.C.L., Pres.R.S., etc., London, Eng.

Professor Oliver J. Lodge, D.Sc., LL.D., F.G.S., University College, Liverpool.
Hugh Robert Mill, D.Sc., F.R.S.E., London, Eng.
Professor Henry A. Miers, F.R.S., F.G.S., Magdalen College, Oxford.
Professor John Milne, F.R.S., F.G.S., Isle of Wight.
Robert Munro, M.A., M.D., Edinburgh.
L. C. Miall, F.R.S., F.L.S., F.G.S., Yorkshire College, Leeds.
Professor Raphael Meldola, F.R.S., F.R.A.S., Finsbury Technical College, London.
Professor Meslans, University of Nancy, France.
Dr. Donald Macalister, M.A., M.D., Cambridge.
John L. Myres, M.A., F.S.A., Oxford.
Professor Edward B. Poulton, F.R.S., F.L.S., University of Oxford.
W. H. Preece, C.B., F.R.S., M.Inst.C.E., Wimbledon Common, Surrey.
Professor W. C. Roberts-Austen, C.B., Royal Mint London.
E. G. Ravenstein, F.R.G.S., F.S.S., London.
Wm. Ramsay, Ph.D., F.R.S., F.C.S., University College, London.
Arthur W. Rucker, M.A., D.Sc., F.R.S., Professor of Physics in the Royal College of Science, London.
Robert Saundby, M.D., F.R.S.P., Birmingham.
A. C. Seward, M.A., F.G.S., Cambridge, Eng.
Professor C. S. Sherrington, M.D., F.R.S., University College, Liverpool.
Sir William Turner, M.B., LL.D., D.C.L., F.R.S., University of Edinburgh.
Professor W. H. Thompson, M.D., Queen's College, Belfast.
Professor William Cawthorne Unwin, F.R.S., M.Inst.C.E., City and Guilds of London Inst.
Professor F. E. Weiss, B.Sc., F.L.S., Owens College, Manchester.
Professor H. Marshall Ward, D.Sc., F.R.S., F.L.S., Cambridge, University.
Professor W. G. Adams, M.A., F.R.S., F.G.S., King's College, London.
Professor Henrici, Ph.D., F.R.S., City and Guilds of London Institute.
Professor Major P. A. McMahon, R.A., F.R.S., Artillery College, Woolwich.
H. W. Seton-Karr, Esq., Wimbledon, Surrey.
Professor John Perry, D.Sc., F.R.S., London, Eng.
Walter Garstang, M.A., F.Z.S., Marine Biologieal Laboratory, Plymouth.
The Rt. Hon. the Earl of Berkeley, Abingdon.
Professor E. M. Crookshank, King's College, London.
G. Griffith, M.A. (Asst.Gen.Sec.), Harrow.
Professor H. McLeod, F.R.S., F.C.S., Royal Indian Civil Engineering College.
Professor C. Lloyd Morgan, F.G.S., Principal, University College, Bristol.
Professor S. P. Thompson, B.A., F.R.S., D.Sc., F.R.A.S., City and Guilds of London Technical College.
Dr. A. W. Waller, F.R.S., London, Eng.
W. T. Blanford, LL.D., F.R.S., F.G.S., London, Eng.
F. C. Selous, Esq., Wargrove, Bucks.
Sir Malcolm Fraser, General Agent for Western Australia.
Dr. D. Noel Paton, Edinburgh.
John A. Campbell, M.D., F.R.S., Carlisle, Eng.
Sir George S. Robertson, K.C.S.I., London, Eng.
Professor Anderson Stuart, University of Sydney, New South Wales.
Major-General Webber, C.B., R.E., M.Inst. C.E.

The following men of science from the Continent are to be present:

Professor Dr. Anton Dohrn, Zoological Station, Naples.
Professor Yves Delage, University of Paris.
Gustave Gilson, University of Louvain, Belgium.
A. Gobert, Brussels.
Professor Dr. Albert Ladenburg, Breslau.
Professor Meslans, University of Nancy, France.
Professor P. Magnus, University of Berlin.
Dr. Ph. Pauli, Frankfurt-am-Main.
Dr. van Rijckevorsel, Netherlands.
Professor C. Runge, Hannover.
Professor Charles Richet, Paris.
Professor Bohuslav Brauner, University of Prag.
Professor Braun, University of Strassburg.
Professor Fittica, University of Marburg, Germany.
Professor K. Hürthle, University of Breslau.
Professor Penck, University of Vienna.

A. B. MACALLUM.

DE VOLSON WOOD.

PROFESSOR DE VOLSON WOOD, whose death was recently noticed in this JOURNAL, was a man of unusual attainments and was for nearly half a century identified with the promotion of that systematic technological education which has come to play so important a rôle in the civilization of the present day. He was born in 1832, and passed the years of his youth on the farm of his father near Smyrna, N. Y. He early displayed the capacities of a successful student and teacher of mathematics. The neighbors used to say that "the stones on Mr. Wood's farm are covered with figures which his son De Volson had used in the solution of problems;" and he began teaching school at the age of 17. After some preliminary studies in a private academy and at Cazenovia Seminary, he went to Albany State Normal School in 1852 and was graduated from that Institution at the end of the following year. During 1853–4 he was principal of the public school of Nopanoch, N. Y.; and during 1854–5 he served the Albany Normal School as assistant professor of mathematics. He then

went to the Rensselaer Polytechnic Institute of Troy, N. Y., where, after two years' work as student and instructor, he was graduated with the degree of civil engineer. Immediately thereafter he became connected with Michigan University, in which he served as assistant professor of civil engineering from 1857 to 1859, as professor of physics and engineering from 1859 to 1860 and as professor of civil engineering from 1860 to 1872. At the end of the latter academic year he resigned his professorship in Michigan University to accept the professorship of mathematics and mechanics in Stevens Institute of Technology, which had been founded the same year. He remained with this institution until his death, holding the professorship of mathematics and mechanics until 1885, and from that year on the professorship of mechanical engineering.

It is an interesting circumstance, which in some measure undoubtedly determined Professor Wood's career, that he went to Michigan University shortly after President Henry Philip Tappan began his remarkable educational work in that institution. Tappan, considering the time in question, was a man of very broad and liberal views concerning educational affairs, and was one of the first to introduce in this country the German ideas of the functions and administration of a university. He was also one of the first of our educators to recognize the value of technological studies, and under his guidance there was established in Michigan University as early as 1855 a four years' course in engineering, to the conduct of which Professor Wood was called two years later. Two other brilliant men of the same institution into whose association Professor Wood was thrown at this time were the distinguished astronomers Francis Brünnow and James C. Watson. A more stimulating intellectual environment than that furnished by these three men could not have been found in this country at that time.

From the time he went to Michigan University, in 1857, to the end of the present academic year Professor Wood was actively engaged in the work of instruction, rarely missing a day from his class-room in forty-one years. During the earlier part, especially, of this long interval, before the differentiation of studies now common had been attained, he gave instruction in a variety of subjects, embracing in fact nearly all those of the mathematico-physical sciences in the engineering curriculum. He was thus brought into intimate contact, and in many cases into prolonged association, with a large body of students who have borne abundant testimony to the exceptional value of his instruction and influence by the range and efficiency of the work they have accomplished. The peculiar merit of his teaching lay in his capacity to make men think laboriously and enthusiastically with their own heads. He was usually able to get students to devote willingly to his subjects three to five times as much labor as they would give to the subjects of other instructors. Being also himself a man of untiring industry, full of suggestions and enquiries, and animated always by a robust and transparent love of the truth, only the dullest students could fail to make creditable progress under his guidance. This genius for industry and this capacity for self-help are the elements of character he succeeded in planting firmly in the long list of engineers who had the good fortune to come under his instruction.

Professor Wood was a frequent contributor to scientific periodicals, particularly those devoted to mathematics and engineering. He was also the author of several text-books widely used in schools of engineering. In this work, as in teaching, his activity was indefatigable to the last, a revised and enlarged edition of his important

work on water motors having been brought out shortly before his death.

In appearance Professor Wood was a striking figure. His large, erect frame and his energetic manner at once commanded attention and respect. Socially he was a most genial and kindly man, full of patience and encouragement, especially for young men. He was of a somewhat retiring and domestic disposition, however, and mingled less with men of the world than might have been expected. Though honored by election to office in the scientific societies to which he belonged, he never sought personal advancement. He was content with his chosen work in the class-room, and the remarkable success he attained in that work amply justifies the singular fidelity with which he devoted his life to it.

R. S. W.

CURRENT NOTES ON PHYSIOGRAPHY.

THE LABRADOR PENINSULA.

Much interesting information about Labrador is to be found in an article by Low in the Annual Report of the Geological Survey of Canada for 1895 (Ottawa, 1897). The fiords of the Atlantic coast are described as valleys of denudation of very ancient origin, eroded when the elevation of the peninsula was greater than now. "Their remote antiquity is established by the deposition in their lower levels of undisturbed sandstones of Cambrian age." A similar explanation is given to the greater river valleys. The 'banks' for some fifteen miles off the coast are shallower than many of the fiords; they are explained as a terminal moraine, somewhat flattened out by floating ice and currents. At least a fourth of the plateau area is occupied by lakes of small depth confined in shallow valleys by barriers of drift. Some of the larger and deeper lakes occupy ancient basins, floored with Cambrian strata. There is a lakeless plain of marine sands and clays carved by deep stream channels, extending inland for a hundred miles eastward from James bay. Much is told about Hamilton river, with its Grand Falls, and Bowdoin* Cañon below them, from which a clear picture of the plateau region may be gained. Erosion by ice is given a small measure; its chief result being to rub down hills and fill neighboring depressions, thus decreasing local relief. "There is no evidence to show that the glacier ever hollowed or scooped out deep depressions, as has been often stated to have occurred elsewhere." The till is frequently arranged in long low ridges, like drumlins, with nearly driftless tracts between them. Eskers are greatly developed, one having a length of nearly a hundred miles. They are ascribed to streams flowing on or below the ice when the glacial sheet had become practically stagnant.

It is difficult to reconcile the statements noted above as to the age of the fiords, the greater valleys and the deeper lakes, with the rates of denudation in resistant rocks elsewhere, unless it be supposed that for most of geological time the Labrador plateau has been covered by an inert ice sheet, protective of very ancient forms rather than productive of new forms; or unless it be supposed that the depressions were long ago made and filled and rather lately re-excavated. In any case, it is hardly possible that "the process of formation of these valleys has continued slowly from [Cambrian time] to the present day by the agency of falling water and of frost." Does the earth's surface exhibit any rocks resistant enough to retain significant slopes after so long an attack of the destructive subaërial forces?

THE CHICAGO AREA.

Leverett describes the Pleistocene features and deposits of the Chicago area

*Bowdoin is unfortunately misspelled *Bodwoin* in the report and on the accompanying map of Labrador.

(Bull. II., Geol. and Nat. Hist. Survey, Chicago Acad. Sciences, May, 1897), including the Valparaiso moraine, the channel cut by the former outlet of Lake Michigan through the moraine and down the Illinois river valley, and the beaches of the former lake. The moraine is concentric with the present lake shore; it is a hilly belt, about ten miles wide and a hundred or more feet higher at the 'crest' than at the borders; its mounds frequently enclose hollows and lakelets. The channel cut by the former lake outlet follows a drift-clogged valley of preglacial origin below Hennepin (where the Illinois river turns from west to south), but is of glacial or post-glacial origin above that point. It is from one to five miles wide, and from 20 to 70 feet deep; its marginal bluffs are steep, like a river bank, throughout the entire length of 300 miles, as if the lake outflow had great volume, filling the channel from bluff to bluff. Three beaches are described, marking the lake shore at the time of the westward outflow. It should here be remembered that the slight difference between the level of the old outlet and of the present lake is not due simply to a slight withdrawal of the waters, but is due to a strong rise of the waters after a strong fall, as has been well shown by several students of the glacial history of the Great Lakes; the fall resulting from the adoption of eastern outlets, and the rise resulting from an elevation of the land in the northeast. So close a return to the Illinois outlet is portentous of the future.

STUDIES IN INDIANA GEOGRAPHY.

SEVERAL papers on the geography of Indiana by various authors have been published in the *Inland Educator* during the past year, and some of them have been referred to in these notes. The whole series is now edited by C. R. Dryer, professor of geography in the Indiana State Normal School, and published in book form (Inland Publishing Co., Terre Haute, Ind., 1897). 'First series' appears on the title page, as if more essays are to follow; and it is to be hoped that such is the case, for much educational good must result from the careful use of such material by teachers. The book is notable in being the first of a kind that should have great extension over the country, as an encouragement and assistance in the study of home geography. There is to-day no similar series of essays even for States as prosperous and as important as Ohio and Pennsylvania. Indeed, it is a difficult matter for the inquiring teacher to find available geographical literature for her work. Professors of geography in other normal schools might well follow the example set by Dryer.

W. M. DAVIS.

HARVARD UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

ANTIQUITY OF MAN IN SWITZERLAND.

THE thirty-fifth volume of the Memoirs of the *Société Helvétique des Sciences Naturelles* is taken up with a thorough analysis of cave exploration near the Rhine, by Dr. Jacob Nuesch and his collaborators. The conclusions he reaches are the more noteworthy because they were obtained after the most exhaustive investigations and comparisons of the fauna, flora and human remains exhumed from the cave-floors. They may be briefly summed up as follows:

The oldest faunas found were sub-arctic and post-glacial. Man was contemporaneous with these, and at that time his industries were distinctly palæolithic. This period lasted about 8,000 years. A long period then elapsed, 8,000 to 12,000 years, during which the fauna changed to modern types, but man seems to have been absent. The neolithic and lake-dwelling period then

began and continued about 4,000 years, closing with the introduction of bronze about 4,000 years ago.

This makes about 28,000 years since man first appeared on Swiss soil; but it must be borne in mind that he may have flourished in milder parts of the continent for indefinite ages before that. The vast Alpine glaciers rendered the climate of Switzerland uninviting long after the continental glacial period had ceased.

MOKI CEREMONIALS.

An instructive article for the student of primitive religions is that by Dr. J. Walter Fewkes on 'The Group of Tusayan Ceremonials called *Katcinas*.' (15th Rep. Bureau of Ethnology.) It is a faithful narration of the strange religious performances, amply illustrated, and the native terms preserved wherever possible.

The word *Katcina* is a vague term for spiritual beings of an inferior class to the highest deities of the tribe, but who are credited with much power over the welfare of the community. They may include the ancestral souls, but are not exclusively these. The ceremonies in their honor are frequent, and distributed throughout the year in a ritual calendar devised by the priestly class. Both men and women participate in them, and they have the character of a sacred drama, as have most primitive rituals. Masks, costumes and traditional songs and chants are prominent features.

Dr. Fewkes finds noticeable resemblances between these ceremonials and those of other Pueblos, but also marked differences. He is impressed with their analogies to those of the ancient Aztecs, and it is likely that throughout America numerous counterparts could be discovered.

D. G. Brinton.

University of Pennsylvania.

NOTES ON INORGANIC CHEMISTRY.

Léon Franck details in the Bulletin of the French Chemical Society some interesting experiments on the formation of metallic sulfids by mechanical action. When a mixture of fine aluminum powder and flowers of sulfur is rubbed between two sheets of paper, hydrogen sulfid is evolved, owing to the formation of aluminum sulfid and its subsequent decomposition. The same reaction takes place between magnesium powder and flowers of sulfur. If an aluminum plate be rubbed with flowers of sulfur, or even with vulcanized rubber, the odor of hydrogen sulfid is distinctly perceptible. With those metals whose sulfids are not decomposed in the air the reaction is different. When a plate of silver is rubbed with flowers of sulfur it gradually darkens, owing to the formation of silver sulfid, and if the action is continued, little prominences of silver sulfid are formed, which can be removed by a knife. Copper and lead give the same reaction as silver.

This reaction corresponds to the well known darkening of silver coins when carried in the pocket with sulfur matches. In the case of blackening of silver spoons by eggs the reaction is somewhat different, as the sulfur is in combination and in solution. The layer of sulfid must in this case be exceedingly thin, for silver spoons which have been used sometimes for more than a generation have been cleaned again and again, perhaps weekly, each time the layer of sulfid being rubbed off, and yet the spoons show apparently little diminution of weight.

In the *Comptes Rendus*, Léon Lémal describes the coloring of glass by the direct penetration of metals or metallic salts, analogous to the cementation process of steel making. If glass is covered with a silver salt, even in small quantity and heated to 500°–550°, on cooling it shows a

yellow to orange-red color, according to the length of time of heating. The depth of penetration of the color depends upon the duration of the reaction. Such glass is yellow by transmitted light, but by reflected light shows a yellowish-green to violet-blue fluorescence. By using a silver photographic plate on red glass colored with copper, it is possible to obtain a picture, visible by reflected light, but not by transmitted light, since the yellow of the picture is obscured by the red glass. Gold, copper and iron give results similar to silver; indeed, all metals experimented with, except manganese, were absorbed by the glass imparting to it color.

A CONTRIBUTION to the effect of light upon the union of hydrogen and chlorin is made by A. Gautier and H. Hélier in the *Comptes Rendus*. A mixture of carefully purified chlorin and hydrogen was kept in sealed tubes in absolute darkness for over fifteen months. No trace of hydrochloric acid was found, and the result was the same, whether the mixture was dry or moist. Similar experiments were tried, but the mixtures were exposed to the light of a candle, four meters away from the tube, and again one meter away. At the end of ten days it was found there had been no hydrochloric acid formed, showing that sunlight, or some source of light containing the more refrangible rays of the spectrum, is necessary for the union of hydrogen and chlorin at ordinary temperatures.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

AN INTERNATIONAL ASSOCIATION.

THE meeting of the British Association in Canada in 1884 was thought a favorable opportunity for the proposal of an International Scientific Association, and the plan was editorially commended in this JOURNAL and supported by Professors Newcomb, Hunt, Minot and other American men of science. At that time Mrs. Elizabeth Thompson gave a fund to be administered by the Association when organized. The second meeting of the British Association in America and the plans for an exchange of courtesies between it and the American Association and between the British and French Associations in 1899, together with the development of international congresses for the separate sciences, seemed to make it desirable again to call attention to the importance of an international association for the advancement of science, and this was done in an article published in the issue of this JOURNAL for October 9, 1896.

The plan was approved in editorial articles in the *Scientific American* and *Appleton's Popular Science Monthly* and was quoted and discussed in foreign scientific journals. For reasons which we need not repeat, the advantages of an international conference seem to outweigh the difficulties, and we should like to see steps taken at the meetings of the American and British Associations for the organization of a congress to meet in 1900. Should it, however, be thought that the time has not yet come, then we should be glad to see the National Associations undertake in alternation to give their meetings an international character. This will to a certain extent be accomplished this year by the British Association. Arrangements should be made next week to secure the representation of foreign associations and societies by delegates at the next meeting of the American Association on the occasion of its fiftieth anniversary.

THE NEW TARIFF LAW.

THE tariff bill, now printed, fortunately contains none of the provisions inimical to science and education, against which we protested when the bill was first presented to the House of Representatives. The present bill does not materially alter the regulations in force during the last four years. The sections of the free list which concern apparatus, books, etc., read as follows:

Philosophical and scientific apparatus, utensils, instruments and preparations, including bottles and boxes containing the same, specially imported in good faith for the use or by the order of any society or institution, ncorporated or established solely for religious, philosophical, educational, scientific or lit-

erary purposes, or for the encouragement of the fine arts, or for the use or by order of any college, academy, school or seminary of learning in the United States, or any State or public library, and not for sale, subject to such regulations as the Secretary of the Treasury shall prescribe.

Books, maps, music, engravings, photographs, etchings, bound or unbound, and charts, which shall have been printed more that twenty years at the date of importation, and all hydrographic charts and scientific books and periodicals devoted to original scientific research, and publications issued for their subscribers or exchanges by scientific and literary associations or academies, or publications of individuals for gratuitous private circulation, and public documents issued by foreign governments.

Books and pamplets printed exclusively in languages other than English; also books and music, in raised print, used exclusively by the blind.

Books, maps, music, photographs, etchings, lithographic prints, and charts, specially imported, not more than two copies in any one invoice, in good faith, for the use or by order of any society or institution incorporated or established solely for religious, philosophical, educational, scientific, or literary purposes, or for the encouragement of the fine arts, or for the use or by order of any college, academy, school, or seminary of learning in the United States, or any State or public library, and not for sale, subject to such regulations as the Secretary of the Treasury shall prescribe.

It may also be noted that the free list includes specimens of natural history, when imported for scientific public collections and not for sale, and wild animals imported for zoological gardens. Personal effects of travellers purchased abroad are limited to the value of $100, but professional books, implements, instruments and tools of trade, occupation or employment, in the actual possession at the time of persons arriving in the United States are free of duty.

THE GOLD RESOURCES OF THE YUKON REGION.

THOSE interested in the gold resources of the Yukon region in Alaska should secure, from the Geological Survey, the report of the expedition made under the direction of Mr. J. E. Spurr last summer, a brief account of which was published in this JOURNAL on November 27, 1896. The party crossed the Chilkoot Pass, about the middle of June, to the headquarters of the Yukon, and proceeded down the river to the chief gold-bearing localities. The principal producing districts, those of Forty-Mile Creek and Birch Creek, were thoroughly explored, as well as other less important localities. The party then continued down the Yukon, examining the younger sedimentaries which overlie the gold-bearing formation, as far as Nulato. One of the principal results of the expedition was the recognition of the gold-bearing rocks from which the gold in the river gravels is derived. These gold-bearing rocks constitute a distinct broad belt running northwest into Alaska from British territory. They are in their lower portions schists and gneisses, with intrusive rocks, and in their upper portion somewhat altered sedimentaries. They are all older than Carboniferous, for the Carboniferous and younger rocks overlie them on both sides of the gold-bearing belt. In this belt the gold occurs partly in quartz veins, partly in deposits formed along shear-zones; in both occurrences it is contained in pyrite, and becomes free on weathering. The quartz veins are distinctly older than the shear-zone deposits, and were formed before the alteration of the enclosing rock to a schist; they have, therefore, partaken of this shearing, and have been broken and sheared so that they are typically non-persistent. The deposits along shear-zones are, however, of later date than the shearing, and can be continuously followed. The younger beds which overlie the gold-bearing belt consist in part of conglomerates, and some of these conglomerates are fossil placers, which give promise of being productive.

GENERAL.

THE French Association for the Advancement of Science is holding its annual meeting simultaneously with that of the American Association. The meeting is at Saint Étienne, under the presidency of M. Marey, the eminent physiologist.

AT a meeting summoned by the Lord Provost of Glasgow, and attended by representatives from the magistrates, the University, St. Mungo's College, the Philosophical and other scientific societies, it was unanimously decided to invite the British Association to meet in Glasgow in the autumn of 1901.

THE German Botanical Society will this year hold its annual meeting at Brunswick, beginning September 21st, in conjunction with the sixty-ninth meeting of the German Society of Men of Science and Physicians.

WE have published programs of the meeting of the British Medical Association at Montreal, beginning August 31st. The Sections of the Association devoted to scientific subjects will undoubtedly attract to Montreal many of the British and American men of science attending the Toronto meeting of the British Association. The annual business meeting of the Medical Association was held in London on July 27th and 28th, and the reports of the Council and of the committees have been published in the *British Medical Journal*, the official organ of the Association, to which journal its great success is in large measure due. The membership of the Association is now 16,955, and the revenue for the past year amounted to $190,000.

WE are requested by the Secretary of the American Society of Naturalists to publish the following communication, read at the last meeting of the Society:

TORONTO, December 24, 1896.

To the Secretary of the American Society of Naturalists.

DEAR SIR: The Local Executive Committee of British Association respectfully calls attention to the fact that the next meeting of the Association will be held in Toronto, August 18–25, and the members of the American Society of Naturalists are invited to become members of the Association for the occasion.

A large number of representative British scientific men have thus early promised to attend and the Local Committee are endeavoring to secure the attendance also of large numbers of distinguished Continental (European) scientific men at the meeting.

Permit me to assure the members of the American Society of Naturalists that everything will be done to make their visit to Toronto an extremely pleasant one.

Yours sincerely,

A. B. MACALLUM,
President of the Local Executive Committee.

THE daughters of Joseph Henry, the first Secretary of the Smithsonian Institution, have presented to the Institution for the National Museum an interesting collection of electrical models devised by Henry, and of decorations, etc., conferred upon him.

THE late Sir Augustus Wollaston Franks, formerly keeper of British and mediæval antiquities of the British Museum, has bequeathed to the Museum his valuable collection of works of art, ornaments and curiosities.

IT is proposed to collect a fund for a memorial at Glasgow to John and William Hunter, the great physiologists. An executive committee for this purpose was appointed at a public meeting recently convened at Glasgow. The movement originated with the late Dr. Mather, and Mrs. Mather, who was present at the meeting, stated that she had a sum of £850 with which to head the subscription list.

PROFESSOR EDGAR MCCLURE, of the Oregon State University, fell 300 feet over a precipice on the Muir Glacier while descending Mount Rainier on July 27th and was killed. Two other members of the Mazama Mountain Climbing Club, Mr. George Rogers and Mr. H. Ainslee, of Portland, Ore., fell into a crevasse on Mt. Rainier forty feet deep, and the former may not recover from his injuries.

SIR JOHN BUCKNELL, F. R. S., the author of important contributions to neurology and insanity, formerly editor of the *Journal of Mental Science* and one of the editors of *Brain* and of the *British Medical Journal*, died at Bournemouth on July 20th, aged 79 years.

MR. A. J. MUNDELLA, the English statesman, who as Vice President of the Council on Education and President of the Board of Trade took an active interest in science and education, died on July 21st, aged 72 years. He was a fellow of the Royal Society and of the Royal Statistical Society.

WE regret also to announce the deaths of the following men of science: Professor Arminio Nobile, professor of geodesy in the University of Rome; Professor Oscar Boer, of Berlin, known for his work on infectious diseases, and Professor Johann Ritter von Leich, formerly dean of the medical faculty of the University of Vienna, at the age of eighty-four.

DR. RADCLIFFE'S trustees have decided to appoint to the post of Radcliffe Observer at Oxford, vacant by the death of the late Mr. E.

J. Stone, Dr. Arthur A. Rambaut, of Dunsink Observatory, Dublin. Dr. Rambaut is Andrews professor of astronomy in the University of Dublin and Royal Astronomer of Ireland.

DR. BRUNO HOFER, docent in zoology at the University of Munich, has been appointed director of the recently established institute for the study of diseases of fishes.

AT a recent meeting of the Council of the British Institute of Preventive Medicine, Dr. Allan Macfadyen was appointed Director of the Institute.

M. GAYON has been elected a member of the Paris Academy of Sciences in the room of the late Professor Hellriegel.

THE official delegates to the recent International Library Conference were as follows: *France*, M. Omont; *Germany*, Dr. Milkau; *Italy*, Signor Biagi; *Sweden*, Dr. Lunstedt; *Hungary*, Dr. Erdelyi; *Japan*, Enjiro Yamazo; of the Anglo-Saxon race—*Great Britain*, Sir Horace Walpole, Mr. C. H. Tawney; *United States*, Dr. Justin Winsor, Mr. Melvil Dewey, Mr. Herbert Putnam; *Canada*, Mr. A. D. de Celles; *New South Wales* and *Victoria*, Mr. H. C. L. Anderson; *New Zealand*, Mr. W. P. Reeves; *Jamaica*, the Rev. Dr. Gillies.

THE chairmen of the committees of the House of Representatives having more or less connection with scientific subjects, appointed by the Speaker before the adjournment of the House, are as follows: Coinage, Weights and Measures, Mr. Stone, of Pennsylvania; Agriculture, Mr. Wadsworth, of New York; Public Lands, Mr. Lacey, of Iowa; Railways and Canals, Mr. Chickering, of New York; Manufacturers, Mr. Faris, of Indiana; Mines, Mr. Grosvenor, of Ohio; Education, Mr. Growe, of Pennsylvania; Patents, Mr. Hicks, of Pennsylvania.

PROFESSOR CHAS. D. WALCOTT, Director of the U. S. Geological Survey, has gone west to inspect and direct the field work of his bureau, more especially the survey and examination of the forest reserves, for which Congress, at its last session, made a special appropriation of $150,000. Mr. Walcott expects to be absent until October. In his absence, Colonel Rizer, the Chief Clerk, is acting as Director.

MR. GEO. H. ELDRIDGE, of the U. S. Geological Survey, has gone to Utah, at the instance of the Secretary of the Interior, to reexamine, in greater detail than was possible at the time of his reconnaissance a year ago, the deposits of Gilsonite and allied Hydrocarbons within the Uncompahgre and Ute Indian reservations.

THE daily papers report that Professor William Libbey, on July 23d, succeeded in scaling the 'Mesa Encantada,' near the Indian village of Acoma, New Mexico. By means of a cannon and rocket apparatus similar to that used by life-savers, a cord was shot over the tableland, and the ropes required in making the ascent were pulled up. All that was found on top which indicated that the tableland might have been inhabited was a pile of rocks which looked as if it had been erected by man. Professor Libbey is said to be convinced that the legends which made the place the site of an ancient village are unfounded.

THE London correspondent of the *Evening Post* cables that the Egyptian government is increasing the staff engaged on the geological survey of upper Egypt for the coming winter so as to keep five distinct parties at work. The survey may possibly develop in time into a scientific bureau of Egyptian natural history. A vote of 100,000 francs has been passed by the French Chamber of Deputies for explorations in Persia this autumn. The convention signed by the Shah gives a monopoly of researches throughout Persia to the French, the conditions being that one-half of the objects found shall pass to the state. M. De Morgan, well known through his investigations in Egypt, will conduct the operations.

MR. GEORGE MURRAY and Mr. V. A. Blackman have gone to the West Indies for the purpose of studying the Plant-Plankton of the Atlantic ocean.

ADVICES from Sydney state that the search party under the leadership of Mr. L. A. Wells has found the bodies of Charles Wells and George L. Jones, who, it will be remembered, were lost nearly two years ago from the main body of the Calvert expedition, engaged in the exploration of West Australia.

GREAT BRITAIN has accepted the proposal of the United States for an international conference on the question of pelagic sealing in the Bering Sea, to be held in Washington during the coming autumn.

THE fourth congress for the study of tuberculosis will be held at Paris during the last week of July, 1898, under the presidency of M. Nocard. The following four questions are proposed for discussion: Sanitaria for consumptives, serums and toxins, the X-rays in diagnosis and treatment, and tuberculosis in the lower animals.

IN connection with the Brussels Exposition, there will be held, from August 9th to 14th, a Congress of Hygiene and Medical Climatology of Belgium and the Congo.

AT the last monthly general meeting of the London Zoological Society it was reported that the additions to the Society's menagerie during the month of June had amounted to 178. Special attention was called to two fine adult King Penguins (*Aptenodytes pennanti*) purchased on June 23d, and a young female Orang-outang (*Simia sotyrus*), brought home from Sumatra, and presented by Dr. H. Dohrn, on June 30th.

MRS. VIRGINIA MONROE has given $30,000 to the Pequot Library Association, the building of which was the gift of the late Albert B. Monroe.

MR. ANDREW CARNEGIE has offered the town of Stirling, Scotland, the sum of £6,000 for a public library building.

THE issue of *Nature* for July 15th contains an appreciative review, by Professor A. G. Greenhill, of the text-book of higher mathematics edited by Professors Merriman and Woodward: "This is a style of mathematical treatise to which we are not accustomed in this country, from the luxury of the print and size of page, as well as for the refreshing novelty and interest of the contents. Till recently it was thought that the study of mathematics was not likely to flourish in America as *trop vieux jeu* by the side of the new physical and biological sciences. To-day, however, it is the American student who is the most enthusiastic follower of recent mathematical development, while we in this country are being left far behind. * * * * * The account, given by the editors in the preface, of the work expected of the average American student, shows that the standard of requirement is much higher than in this country and not hampered by traditional prejudice."

THE anatomical departments of the *Journal of Anatomy and Physiology* will hereafter be edited by Professors Turner, MacAlister, Cunningham and Thane. Professor M'Kendrick will continue to edit the physiological department.

UNIVERSITY AND EDUCATIONAL NEWS.

THE University of London Bill has been introduced into the House of Lords by the Duke of Devonshire and has been read for the second time.

THE United States Circuit Court at Baltimore, on July 29th, handed down a decision that the Johns Hopkins University and other holders of first preferred 6 per cent. stock of the Baltimore and Ohio Railroad are not preferred creditors. The trustees of the University hold nearly $2,000,000 of the preferred stock, bequeathed by the founder of the University, the late Johns Hopkins, and this decision, if upheld by the higher Courts, will seriously and permanently curtail the income of the University.

As was stated in this JOURNAL last autumn, it is proposed to draw up plans for buildings such as the University of California hopes ultimately to erect. We fear, however, that the sum of $4,000,000, which the daily papers report to have been subscribed for the erection of these buildings, has not as yet been secured.

IT is reported in the daily paper that Dr. E. Benjamin Andrews, who resigned the presidency of Brown University for reasons given in our last issue, has accepted the presidency of a new 'university' to be founded by Mr. John Brisben Walker, proprietor and editor of the *Cosmopolitan Magazine*, and to be known as the 'Cosmopolitan University.' It is to be modelled after the Chautauqua School and to be conducted by correspondence.

PROFESSOR HENRY KRAEMER, of the Northwestern University, has been called to the chair of botany and microscopy in the Phila delphia College of Pharmacy, and Dr. Albert

Schneider, Ph.D. (Columbia), has been called to the chair in Northwestern University vacant through the resignation of Professor Kraemer.

Dr. L. Schlesinger, of Bonn, has been appointed full professor of mathematics at Klausenburg; Dr. Detmer, associate professor of botany in the University of Jena, has been promoted to a full professorship; Dr. Lassar Cohn, professor of chemistry in the University at Königsberg, has been elected director of the Liebig Akademie of Munich; Dr. A. O. Kihlman has been appointed associate professor of botany at Helsingfors, and Dr. G. J. Ptaschicky, professor of zoology in St. Petersburg; Dr. F. v. Luschan, docent in the University of Berlin, has been promoted to a professorship of anthropology; Dr. Seelhorst, director of the Agricultural Experiment Station at Göttingen has accepted a professorship in the Agricultural College at Hohenheim.

DISCUSSION AND CORRESPONDENCE.

COLOR STANDARDS.

It is a matter for congratulation that the subject of color standards and definitions has been brought before the public for discussion in Science* Education in any branch of knowledge becomes simple and successful in proportion as its terminology is definite and intelligible. It would be quite interesting to set forth the plans that have been offered for obtaining color standards; one proposes to take an orange as the type of that color, and in like manner to let a lemon, an olive, etc., be the ultimate definition of those hues. One has even suggested a collection of wines of various colors as standards, and the matching of other colors by mixing the wines, an operation as dangerous as it is unscientific.

In the search for standards we must first be able to define completely a colored surface; not by saying that it resembles or differs to a certain extent from some other arbitrary surface, but it must be defined in terms of certain invariable and readily reproducible standards.

To describe completely a surface we must give value to four factors which go to affect the impression which it produces upon the normal observer: First, the predominating wave-length or wave-lengths of the light coming from it; second, its total luminosity, as compared with some standard; third, its saturation, or the ratio of the colored light to the total luminosity; fourth, its texture.

* See article in Science, July 16, p. 89.

The matter of texture may be eliminated by placing the surface far enough from the eye, or, better, by rotating it so rapidly that the eye cannot distinguish the texture; consequently a standard of texture is unnecessary. A standard of total luminosity is easily obtained by holding a cold surface over burning magnesium or zinc; the coating of oxide thus produced has been adopted as 'white' by Rood, Mayer and others. In other words, the luminosity of such a surface is taken as 100 %. A box about five feet in length and one in cross-section, lined with black velvet and provided with an opening about four inches in diameter in one end, when so mounted that light cannot shine directly into the opening, will furnish an admirable standard black, or 0 % luminosity. Between these two extremes fall all surfaces not incandescent. White cardboard and lamp-black form very convenient 'practical units,' and their relation to the standards can at any time be easily and accurately determined. The question of saturation, or the ratio of the energy of the predominating characteristic wave-lengths to the total visible energy, is serious. In fact, for the present we must be satisfied to agree upon some temporary standards which may ultimately be absolutely determined.

As to the predominating or characteristic wave-length or wave-lengths we might, of course, refer everything to the spectrum and define by it directly, but it would be a very elaborate and inconvenient method. It is, however, customary to adopt a few typical wave-lengths and define by combinations of these. Theoretically three such colors are sufficient, but practical convenience makes it desirable to have five or six. Then a mixture of these, with the addition of black and white when necessary, enable the observer to match any color, shade, tint or hue.

What shall govern the choice of the five or six working standards? Of course, we expect red, green and blue; probably yellow, and pos-

sibly orange and violet. At first the scientific method would seem to be to choose from the spectrum itself and locate those colors ideally, but we wish concrete surfaces of paper or similar material for our working standards, and if we choose our colors thus can we match them in practice? Chromolithography can do wonders and can nearly match a spectrum color. The objection, however, to such working standards is that each lithographer, and indeed the same one at different times, will succeed to different degrees, so that a slight variation in color, luminosity and saturation is inevitable.

Moreover, practically all the lithographic inks used in such work will fade, and fade surely and badly, a fatal objection to their use as standards. Another way to choose the working colors is to have in mind the pigment to be used in representing the color, as well as the particular wave-length desired.

It was the apparent advantages of the latter method, as well as the advice of good authorities, which led us to follow it in the choice of our working standards when we were asked to prepare the material in the 'Standard Dictionary.' In our choice we were influenced by the following considerations: Emerald green (Paris green) is of the desirable color, is very uniform and is easily obtained; similar advantages recommend artificial ultra-marine blue. For a red, evidently a vermilion should be taken, and in selecting 'English vermilion' we may have erred, but believe it the most uniform and best suited. Mineral orange seemed very nearly identical in different samples, and was adopted since its color was that desired. As to chrome yellow it may be very truly urged that there are great variations, but when the samples are chosen by wave-length the character of the yellow is identical. The lack of a good, permanent violet pigment, as well as the apparent lack of the necessity of having a violet standard induced us to omit it. These pigments can be obtained everywhere, and for most purposes true enough to wave-length. They fade but slightly, if at all, and when mixed with thick gum arabic solution and applied like an oil paint to completely cover the surface their total luminosity and saturation is always practically the same. They thus furnish working standards which can be reproduced by anybody in any part of the world with great accuracy if necessary. Together with white cardboard and lamp black carried in shellac they enable an observer to produce practically any color, shade, hue or tint, by combining them as Maxwell disks.

Other pigments, other colors, may finally prove more worthy of general and final adoption, but it seems to us that the considerations which influenced us most seriously influence the final selection.

No doubt Mr. Pillsbury regretted that his system was not adopted for the 'Standard Dictionary', but that should not have induced him to insinuate that we copied his system, or to refer to a typographical error as 'an unintentional blunder.' We have no desire to belittle the work of Milton Bradley or Mr. Pillsbury, for they are doing much for the introduction of scientific methods into color study, but it did not seem best to us to attempt to define all colors, using only two colored discs at a time, and we do not believe that any lithographed surfaces should be adopted as ultimate standards, even though they may prove best adapted to educational purposes.

W. HALLOCK,
R. GORDON.

THE TERM 'INTERNAL SECRETIONS.'

TO THE EDITOR OF SCIENCE: At the beginning of his interesting paper on 'The Physiology of Internal Secretions,' SCIENCE, No. 132, Dr. Howell says: "We owe the term 'internal secretions' to Brown-Séquard, by whom it was first used in published communications dating from 1891." It may be worth while to note that Claude Bernard in his famous 'Rapport sur les progrès et la marche de la physiologie générale en France,' 1867, says, at page 73, "La cellule sécrétoire, au contraire, attire, crée et élabore en elle même le produit de sécrétion, qu'elle verse soit au dehors sur les surfaces muqueuses, soit directement dans la masse du sang. J'ai appelé *sécrétions externes* celles qui s'écoulent en dehors, et *sécrétions internes* celles qui sont versées dans le milieu organique intérieur."

C. B. DAVENPORT.

MUS. COMP. ZOOL., July 26, 1897.

SCIENTIFIC LITERATURE.

Vorlesungen über die Elektromagnetische Theorie des Lichts, von H. VON HELMHOLTZ. Herausgegeben von ARTHUR KÖNIG und CARL RUNGE. Hamburg and Leipzig, Verlag von Leopold Voss. 1897.

Since the experiments of Hertz proved the existence of electro-magnetic waves propagated through dielectrics, the attention of an increasing number of physicists has been turned to the careful study of Maxwell's 'Electro-magnetic Theory of Light,' and the belief has become practically universal that this theory, in its general outlines at least, corresponds closely to physical facts. Several hundred important papers on matters more or less nearly related to the theory have been published during the last ten years, and the results of investigation have been made fairly accessible to students through the books of Boltzmann, Drude, Hertz, Poincaré, J. J. Thomson and others. When, however, a great university teacher, who has had much to do with the creating of a new branch of science, writes a systematic treatise on the subject for the use of his pupils, the event must always be of interest to the scientific world, and this is especially true when the subject is so important and in some respects still so abstruse as the Electro-magnetic Theory of Light is. The lectures, which are now published under the editorship of Professors König and Runge, were delivered substantially in their present form by Helmholtz in the Winter Semester of 1892–93. An accurate stenographic report of the words of the lecturer was made by Dr. Borchardt, and this report, with slight editorial changes, made in part by Helmholtz himself, and with some additions, made by his directions, to the chapters on Geometrical Optics, is reproduced in a beautifully printed royal octavo volume of about 370 pages.

The lectures begin with a short account of the Newtonian and the Huyghenian Theories of Light and of the objections to each of them. A discussion of the conditions which the propagation of plane longitudinal and transverse waves through elastic media presupposes, makes clear the necessity of ascribing to the ether the elastic properties of a solid, if it is to transmit transverse vibrations mechanically, and leads naturally to a preliminary presentation of Maxwell's theory based on Faraday's conceptions of magnetic and dielectric polarizations. After this introduction, a long chapter is devoted to a very simple and clearly written but very complete discussion of electro-magnetic oscillations, intelligible to any person who already has a fair knowledge of the meaning of polarization and of the differences between 'real,' 'apparent' and 'induced' magnetic and electric densities. This discussion calls attention anew to the fact that the nomenclature and the notation of the subject are in a very unsatisfactory state. Helmholtz himself sometimes defined inductivity so as to make that of the ether 1 and sometimes so as to make it 4π, and the editors of these lectures were obliged to change the notation in some places so as to make the whole book consistent. The subject will be needlessly difficult for students so long as different writers give the name 'polarization,' without any modifying clause, to three very different quantities.

In transforming Maxwell's equations for electro-magnetic fields, Helmholtz treats the principles first elucidated in his own great paper on Vortex Motion, published in 1858, simply as analytical devices useful in integrating differential equations of a certain form. Neither here nor elsewhere in the book does the lecturer make any reference to his own contributions to the subject. In the third chapter the properties of spherical waves are studied in detail, and Huyghens's Principle is put into a very satisfactory shape by the help of an extended form of Green's Theorem in which the time and the space coordinates appear as independent variables. This makes it possible to treat Diffraction, Interference and Geometrical Optics in the next two chapters very much as they are treated in older books on the Undulatory Theory of Light.

The final chapter is devoted mainly to Polarization, Absorption and Dispersion, and is especially interesting since it gives the author's theory of Dispersion in its latest form. This theory assumes that every molecule of matter is made up of two ions, one charged positively and the other negatively. The amounts of these two charges in any molecule are very large and numerically equal, and each depends only upon

the valency of the ion in that molecule and not upon the chemical nature of the ion. Under the influence of electric force, the ions in any molecule may be made to take up a new position while their center of mass remains fixed. If the force varies periodically, a part of the energy of the field is used in keeping up the oscillations of the ions about this center of gravity in the face of heat losses. Helmholtz applies Hamilton's Principle to the equation of energy and arrives at results which correspond fairly well to observed facts.

The whole book is written in delightfully simple language and seems to be quite free from typographical errors. We merely note, in passing, that George Green held a fellowship in Cambridge from 1839 until his death in 1841, but never a professorship there. These lectures form one of a projected set of six volumes of Helmholtz's Vorlesungen über Theoretische Physik which will be extremely useful to students of physics all over the world.

Harvard University. B. O. Peirce.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

GENERAL PROGRAM.

The regular meeting of the Council will be at the Hotel Cadillac (hotel headquarters) at noon on August 7th.

On Monday, August 9th, at 9 a. m., the Council will meet in the Council Room, Central High School.

The first General Session of the Association will be held at 10 a. m., in the Auditorium of the Central High School. Owing to the death of Professor Edward D. Cope, the President of the Association, Professor Theodore Gill, of Washington, D. C., as Senior Vice-President, will call the meeting to order and introduce the President-elect, Professor Wolcott Gibbs, of Newport, R. I. Addresses of welcome will be made by his Honor Mayor William C. Maybury and Hon. Thomas W. Palmer, and President Gibbs will reply. Announcements by the General, Permanent and Local Secretaries will then be made.

The Addresses of the Vice-Presidents will be given in the afternoon as recorded below. In the evening Professor Theodore Gill, of Washington, D. C., will give a memorial address on the life and work of the late President, Professor Edward D. Cope. Following this address there will be a reception given by the citizens of Detroit.

On Tuesday, Wednesday, Thursday and Friday the regular meetings of the Council will be held at 9 a. m. and of the general session at 10 a. m., followed in the mornings and afternoons by the meetings of the sections.

On Friday morning officers will be elected and an agreement reached on the place of meeting for 1898, the fiftieth anniversary of the Association. The concluding exercises and adjournment of the sections of the Association and a social reunion and reception by the Ladies' Reception Committee will take place in the evening.

On Saturday there will be an excursion to Ste. Claire Flats.

It is expected that the members of the Association at Detroit will go in a body to Toronto to join in welcoming the members of the British Association to America. For this purpose special rates will probably be secured by steamer and train from Detroit to Toronto.

The programs of the sections are given below. These are as complete as possible up to the time of issue of this number of Science, but other papers will be presented at the meeting and entered on the daily programs.

SECTION A.—MATHEMATICS AND ASTRONOMY.

Address of the Vice-President: A Chapter in the History of Mathematics. By Professor W. W. Beman, University of Michigan, Ann Arbor, Mich.

1. A Problem in Substitution-groups. By Dr. G. A. Miller, Ann Arbor, Mich.

2. Continuous Groups of Spherical Transformations in Space. By Professor H. B. Newson, Lawrence, Kans.

3. The Treatment of Differential Equations by Approximate Methods. By Professor W. F. Durand, Ithaca, N. Y.

4. Commutative Matrices. By Professor J. B. Shaw, Jacksonville, Ill.

5. On the Theory of the Quadratic Equation. By Professor A. Macfarlane, Lehigh Univ., South Bethlehem, Pa.

6. A New Principle in solving certain Linear

Differential Equations that occur in Mathematical Physics. By Professor A. Macfarlane, Lehigh Univ., South Bethlehem, Pa.

7. Condition that the Line common to n-1 planes in an n-space may lie on a given Quadric Surface in the same space. By Dr. Virgil Snyder, Ithaca, N. Y.

8. The Psychology of the Personal Equation. By Professor T. H. Safford, Williamstown, Mass.

9. Compound Determinants. (Preliminary Communication.) By Professor W. H. Metzler, Syracuse, N. Y.

10. Waters within the Earth. By W. S. Auchincloss, C.E., Philadelphia, Pa.

11. On the Secular Motion of the Earth's Magnetic Axis. By Dr. L. A. Bauer, Univ. of Cincinnati, Cincinnati, O.

12. Simple Expressions for the Diurnal Range of the Magnetic Declination and of the Magnetic Inclination. By Dr. L. A. Bauer, Univ. of Cincinnati, Cincinnati, O.

13. The Theory of Perturbations and Lie's Theory of Contact-transformations. By Dr. E. O. Lovett, Baltimore, Md.

14. On Rational Right Triangles. No. I. By Dr. Artemas Martin, U. S. Coast Survey, Washington, D. C.

15. Some Results in Integration expressed by the Elliptic Integrals. By Professor James McMahon, Cornell Univ., Ithaca, N. Y.

16. Modification of the Eulerian Cycle due to Inequality of the Equatorial Moments of Inertia of the Earth. By Professor R. S. Woodward, Columbia Univ., New York.

17. Integration of the Equations of Rotation of a Non-rigid Mass for the case of Equal Principal Moments of Inertia. By Professor R. S. Woodward, Columbia Univ., New York.

18. General Theorems concerning a certain class of Functions deduced from the properties of the Newtonian Potential Function. By Dr. J. W. Glover, Ann Arbor, Mich.

19. The Importance of Adopting Standard Systems of Notation and Coordinates in Mathematics and Physics. By Professor Frank H. Bigelow, U. S. Weather Bureau, Washington, D. C.

20. A Remarkable Complete Quadrilateral among the Pascal Lines of an Inscribed Six-point of a Conic. By Professor R. D. Bohannan, Columbus, Ohio.

JAMES MCMAHON,
Secretary of the Section.

CORNELL UNIVERSITY.

SECTION B.—PHYSICS.

Address of the Vice-President: Long Range Temperature and Pressure Variables in Physics. By Dr. Carl Barus, Brown University, Providence, R. I.

1. Screening Effects of Induced Currents in Solid Magnetic Bodies in an Alternating Field. By Mr. Charles P. Steinmetz, General Electric Company, Schenectady, N. Y.

2. The Design, Construction and Test of a 1250 Watts Transformer. By Professor Henry S. Carhart, Univ. of Mich., Ann Arbor, Mich.

3. Electrolytic Action in a Condenser. By Dr. K. E. Guthe, Instructor in Physics, Univ. of Mich., Ann Arbor, Mich.

4. On the Velocity of Light in a Magnetic Field. By Professor E. W. Morley, Cleveland, Ohio; Professor H. T. Eddy, Minneapolis, Minn., and Professor D. C. Miller, Cleveland, Ohio.

5. The Magnetic Survey of Maryland. By Dr. L. A. Bauer, Univ. of Cincinnati, Cincinnati, Ohio.

6. The Transmission of Radiant Heat by Gases at Varying Pressures. By Mr. Charles F. Brush, Cleveland, Ohio.

7. On the Rate at which Hot Glass absorbs Superheated Water. By Professor Carl Barus, Brown Univ., Providence, R. I.

8. A New Method of determining the Specific Heats of Liquids. By Robert L. Litch, A.M., Bethlehem, Pa.

9. On the Coefficient of Expansion of Certain Gases. By Professor Edward W. Morley, Cleveland, Ohio, and Professor Dayton C. Miller, Cleveland, Ohio.

10. The Effect of Heat on the Elastic Limit and Ultimate Strength of Copper Wire. By Professor Frank P. Whitman, Adelbert College, Cleveland, Ohio, and Mary C. Noyes, Ph.D., Lake Erie Seminary, Painesville, Ohio.

11. A Method of obtaining Capillary Canals of Specified Diameter. By Professor Carl Barus, Brown Univ., Providence, R. I.

12. Kites and their Use by the Weather

Bureau in Explorations of the Upper Air. By Professor C. F. Marvin, U. S. Weather Bureau, Washington, D. C.

13. Experiments upon the Acetylene-Oxygen Standard of Light. By Dr. Clayton H. Sharp, Cornell Univ., Ithaca, N. Y.

14. Arc Spectra. By Professor Arthur L. Foley, Univ. of Indiana, Bloomington, Indiana.

15. On the Brightness of Pigmented Surfaces under Various Sources of Illumination. By Professor Frank P. Whitman, Adelbert College, Cleveland, Ohio.

16. Note on the Construction of a Sensitive Radiometer. By Professor Ernest Fox Nichols, Colgate Univ., Hamilton, N. Y.

17. Photographs of Manometric Flames. By Dr. Edward L. Nichols, Cornell Univ., Ithaca, N. Y., and Professor Ernest Merritt, Ithaca, N. Y.

18. The Discharge of Electrified Bodies by X-rays. By Dr. C. D. Child, Cornell Univ., Ithaca, N. Y.

19. A Final Determination of the Relative Lengths of the Imperial Yard of Great Britain and the Meter of the Archives. By Professor William A. Rogers, Colby Univ., Waterville, Me.

20. The Electric Conductivity of certain Specimens of sheet Glass, with reference to their Fitness for Use in Static Generators. By Professor Dayton C. Miller, Case School of Applied Science, Cleveland Ohio.

21. Graphical Treatment of Alternating Currents in Branch Circuits in case of Variable Frequency. By Professor H. T. Eddy, Minneapolis, Minn.

22. On Simple Non-Alternating Currents. By Professor Alexander Macfarlane, Lehigh University, South Bethlehem, Pa.

23. Exhibition of Instruments for determining the Frequency of an Alternating Current. By Professor George S. Moler, Ithaca, N. Y., and Dr. Frederick Bedell, Cornell University, Ithaca, N. Y.

24. The predetermination of Transformer Regulation. By Dr. F. Bedell, Cornell University, Ithaca, N. Y.; Professor R. E. Chandler, Salem, Va., and Mr. R. H. Sherwood, Jr., Brooklyn, N. Y.

25. The effect of Pressure on the Wave-lengths of the lines of the Emission Spectra of the Elements. By Dr. W. J. Humphreys, Johns Hopkins University, Baltimore, Md.

26. A New Form of Coal Calorimeter. By Charles L. Norton, Massachusetts Institute of Technology, Boston, Mass.

27. Notes on the Recent History of Musical Pitch in the United States. By Professor Chas. R. Cross, Massachusetts Institute of Technology, Boston, Mass.

28. A New Form of Harmonic Analyzer. By Dr. Frank A. Laws, Massachusetts Institute of Technology, Boston, Mass.

29. A Comparison of Rowland's Thermometers with the Paris Hydrogen Scale, and the Corresponding Correction to his Value of the Mechanical Equivalent of Heat. By Dr. W. S. Day, Johns Hopkins University, Baltimore, Md.

30. The Determination of the Surface Tension of Water, and of Certain Aqueous Solutions, by means of the Method of Ripples. By Dr. N. Ernest Dorsey, Johns Hopkins University, Baltimore, Md.

31. The Series of International Cloud Observations made by the U. S. Weather Bureau, and their relation to Meteorological Problems. By Professor Frank H. Bigelow, U. S. Weather Bureau, Washington, D. C.

32. The Effects of Tension and Quality of the Metal upon the Changes in Length produced in Iron Wires by Magnetization. By Byron Briggs Brackett, Johns Hopkins University, Baltimore, Md.

33. Measurement of Small Gaseous Pressures. By Charles Brush.

Frederick Bedell,
Secretary of the Section.

Cornell University.

SECTION C.—CHEMISTRY.

Address of the Vice-President: Expert Testimony. By Professor W. P. Mason, Rensselaer Polytechnic Inst., Troy, N. Y.

The meetings of the Section will be held in conjunction with those of the *American Chemical Society.*

The papers of the Section will be divided into sub-heads with following committee in charge: A. B. Prescott, Organic Chemistry; W. A.

Noyes, Inorganic Chemistry; L. M. Dennis, Analytical Chemistry; H. W. Wiley, Agricultural Chemistry; Wm. McMurtrie, Industrial Chemistry.

The departments of Physical Chemistry and of Physiological Chemistry are not, as yet, filled.

Papers Presented to Secretary, A. A. A. S.

1. Recent Progress in Agricultural Chemistry. By Professor H. W. Wiley, Department of Agriculture, Washington, D. C.

2. Calculations of Calorimetric Equivalents of Agricultural Products from Chemical Analyses. By Professor H. W. Wiley and W. D. Bigelow, Department of Agriculture, Washington, D. C.

3. A Study of the Methods of Starch Determination in Agricultural Products. By Professor H. W. Wiley and W. H. Krug, Department of Agriculture, Washington, D. C.

4. The Action of Oxide of Manganese on Potassium Permanganate. By Chas. L. Reese, Baltimore, Md.

5. The Chemistry of Methylene. By Professor J. U. Nef, University of Chicago, Ill.

6. The Poisons of the Tuberculosis Bacillus. By Dr. E. A. de Schweinitz, Department of Agriculture, Washington, D. C.

7. The Action of Nitric Acid upon Aluminium and the Formation of Aluminium Nitrate. By Professor J. B. Stillman, Stevens Institute of Technology, Hoboken, N. J.

8. On the Action of Nitric Acid on Metals. By G. O. Higley.

9. Street Washings. By Professor L. P. Kinnicutt, Polytechnic Institute, Worcester, Mass.

10. Plastering and Mortar. By Professor L. P. Kinnicutt, Worcester, Mass.

11. Qualitative Analysis; a point in teaching that was not a full success. By Professor A. L. Green, Purdue University, Lafayette, Ind.

12. Annual Report on Indexing Chemical Literature. By Dr. H. C. Bolton, Washington, D. C.

13. On the Action of Sodium on Methylpropylketon and on Acetophenon. By Professor Paul C. Freer, University of Michigan, Ann Arbor, Mich.

14. On the Constitution of some Hydrazones. By P. C. Freer, Ann Arbor, Mich.

15. Position in the Periodic Law of the Important Elements found in Plant and Animal bodies. By Professor Harry Snyder, University of Minnesota, Minneapolis, Minn.

16. On two polymeric series of Phosphorus-Nitrogen compounds and on the Stereochemistry of Phosphorus and Nitrogen. By Dr. H. N. Stokes, United States Geological Survey, Washington, D. C.

17. The Chemical Composition of Cement Plaster. By Prof. E. H. S. Bailey, University of Kansas, Lawrence, Kan.

18. Recent Progress in Analytical Chemistry. By Professor L. M. Dennis, Cornell University, Ithaca, N. Y.

19. Alkyl Bismuth Iodides. By Professor A. B. Prescott, University of Michigan, Ann Arbor, Mich.

20. Kola tannin. By Professor A. B. Prescott, Ann Arbor, Mich.

21. A new form of Discharger for Spark Spectra of Solutions. By Professor L. M. Dennis, Cornell University, Ithaca, N. Y.

22. Recent Progress in Industrial Chemistry. By Professor Wm. McMurtrie, New York City.

23. On Solutions of Silicates of the Alkalies. By Dr. Louis Kahlenberg and A. T. Lincoln, University of Wisconsin, Madison, Wis.

Papers Presented to the Secretary of the American Chemical Society.

1. The Law of Solution. By Willis R. Whitney.

2. A New Thermostat. By Willis R. Whitney.

3. A Lecture Experiment illustrating the Law of Reactions of the First Order. By Willis R. Whitney.

4. Contributions to the Chemistry of Didymium. By L. M. Dennis and E. M. Chamot.

5. A Comparison of Methods for Determining Carbon Dioxide and Carbon Monoxide. By L. M. Dennis and C. G. Edgar.

6. Some New Compounds of Hydronitric Acid. By L. M. Dennis and C. H. Benedict.

7. A Preliminary Thermo-Chemical Study of Iron and Steel. By E. D. Campbell and Firman Thompson.

8. Further Study on the Influence of Heat-Treatment and Carbon upon the Solubility of Phosphorus in Steel. By E. D. Campbell and S. C. Babcock.

9. The Action of Certain Bodies on the Digestive Ferments. By Frank D. Simons.

10. The Decomposition of Heptane and Octane at High Temperatures. By A. W. Burwell.

11. Calculation of Calorimetric Values from Analytical Data. By H. W. Wiley.

12. The Chemical Composition of Cement Plaster. By E. H. S. Bailey.

13. Bacterial Products of Hog Cholera and Swine Plague. By E. A. de Schweinitz.

14. Detection of Foreign Fats in Butter and Lard. By C. B. Cochran.

15. Distillation in General. By Leon Labonde.

16. Apparatus for Photometric Determination of Lime and Sulphuric Acid. By J. I. D. Hinds.

17. The Composition of Humus. By Harry Snyder.

18. An Electrical Laboratory Stove. By M. D. Sohon.

P. C. Freer,
Secretary of the Section.
University of Michigan.

SECTION D.—MECHANICAL SCIENCE AND ENGINEERING.

Address of the Vice-President: The Groundwork of Dynamics. By Professor John Galbraith, School of Practical Science, Toronto.

1. Development of Engineering Industries by Scientific Research. By Professor W. S. Aldrich, W. Va. University, Morgantown, W. Va.

2. The Cement Laboratory as a Field for Investigation. By Professor F. P. Spalding, Cornell University, Ithaca, N. Y.

3. The Effect of Spark Losses on the Efficiency of Locomotives. By Professor W. F. M. Goss, Purdue University, Lafayette, Ind.

4. A New Apparatus for Testing Indicator Springs. By Professor M. E. Cooley, University of Michigan, Ann Arbor, Mich.

5. Flue Gas Analysis in Boiler Tests. By Professor D. S. Jacobus, Stevens Institute, Hoboken, N. J.

6. Effect of Temperature on the Strength of Steel. By Professor R. C. Carpenter, Cornell University, Ithaca, N. Y.

7. The Properties of Aluminum Alloys. By Professor R. C. Carpenter, Ithaca, N. Y.

8. Analysis of Composite, Concrete and Iron Beams. By Professor J. B. Johnson, Washington University, St. Louis, Mo.

9. Definition of Elastic Limit for Practical Purposes. By Professor J. B. Johnson, St. Louis, Mo.

10. Theories of some Planimeters without the aid of Calculus. By Professor Forest R. Jones, University of Wisconsin, Madison, Wis.

11. The Production of X-Rays by Means of the Planté Accumulator, in which voltage is chiefly concerned, the effect of current being largely eliminated (Illustrated by Stereopticon.) By Professor W. A. Rogers, Colby University, Waterville, Me.

12. A Universal Alternator for Laboratory Purposes. By Professor Henry S. Carhart, University of Michigan, Ann Arbor, Mich.

13. Calculation of the Energy Loss in Armature Cores. By Professor W. E. Goldsborough, Purdue University, Lafayette, Ind.

14. A New Formula for Determining the Width of Leather Belting. By Professor John J. Flather, Purdue University, Lafayette, Ind.

15. A Graphical Solution of Belting Problems. By Professor John J. Flather, Lafayette, Ind.

16. On Engineering Conditions connected with the Mounting of Instruments used on Eclipse Expeditions. By Professor David P. Todd, Amherst College, Amherst, Mass.

John J. Flather
Secretary of the Section.
Purdue University.

SECTION E.—GEOLOGY AND GEOGRAPHY.

Address of the Vice President: The Pittsburg Coal Bed. By Professor I. C. White, University of West Virginia, Morgantown, West Va.

1. Stylolites. By Professor T. C. Hopkins, State College, Centre Co., Pa.

2. A Suggestion in Regard to the Theory of Volcanoes. By Professor William North Rice, Wesleyan Univ., Middletown, Ct.

3. The Ores and Minerals of Cripple Creek, Colorado. By H. P. Parmelee, Charlevoix, Mich.

4. Observations on the Genus Barrettia. By Professor R. P. Whitfield, American Museum of Natural History, New York, N. Y.

5. Changes of Level in Mexico. By Dr. J. W. Spencer, Washington, D. C.

6. An Account of the Researches relating to the Great Lakes. By Dr. J. W. Spencer, Washington, D. C.

7. Lake Chicago and the Chicago Outlet. By Frank Leverett, U. S. Geological Survey, Denmark, Iowa.

8. The Lower Abandoned Beaches of Southeastern Michigan. By Frank B. Taylor, Fort Wayne, Ind.

9. Recent Earth Movement in the Great Lake Region. By G. K. Gilbert, U. S. Geological Survey, Washington, D. C.

10. Pre-glacial Topography and Drainage of Central-Western New York. By Professor H. L. Fairchild, University of Rochester, Rochester, N. Y.

11. Progress of Hydrographic Investigations by the U. S. Geological Survey. By F. H. Newell, U. S. Geological Survey, Washington, D. C.

12. The Geological Age and Fauna of the Huerfano Basin in Southern Colorado. By Professor Henry F. Osborn, Columbia University.

13. A Supplementary Hypothesis respecting the Origin of the American Loess. By Professor T. C. Chamberlin, University of Chicago.

Other papers will be read before the Geological Society of America.

C. H. Smyth, Jr.,
Secretary of the Section.

Hamilton College.

SECTION F.—ZOOLOGY.

Address of the Vice-President: The Spread of Species by the Agency of Man, with especial reference to Insects. By Professor L. O. Howard, Department of Agriculture, Washington, D. C.

1. On the Relationships of the Nematognaths. By Professor Theo. Gill, Columbian University, Washington, D. C.

2. Remarks on the Distribution of Scale-insect Parasites. By Dr. Leland O. Howard, Department of Agriculture, Washington, D. C.

3. On a collection of Cephalopoda from the 'Albatross' Expedition. By Professor William E. Hoyle, Owens College, Manchester, England.

4. On the Characters of the Brains of Nematognaths and Plectospondyls. By Dr. Benjamin T. Kingsbury, Ithaca, N. Y.

5. The Insect Fauna of Cereus giganteus. By Henry Guernsey Hubbard, Washington, D. C.

6. On the Sarcostyles of the Plumularidæ. By Professor C. C. Nutting, State University of Iowa.

7. Skeletons and Restorations of Tertiary Mammalia. By Professor Henry F. Osborn, Columbia University, New York.

C. C. Nutting,
Secretary of the Section.

University of Iowa.

SECTION G.—BOTANY.

Address of the Vice-President: Experimental Morphology. By Professor George F. Atkinson, Cornell University, Ithaca, N. Y.

1. *Trillium grandiflorum* (Michx.) Salisb.; its Variations, normal and teratological. By Professor Chas. A. Davis, Alma College, Alma, Mich.

2. Contributions on Wild and Cultivated Roses of Wisconsin and Bordering States. By J. H. Schuette, Green Bay, Wis.

3. A Discussion of the Structural Characters the Order *Pezizineæ* of Schroeter. By Dr. E. J. Durand, Cornell University, Ithaca, N. Y.

4. The Taxonomic Value of Fruit Characters in the Genus *Galium*. By K. M. Wiegand, Cornell University, Ithaca, N. Y.

5. Changes during winter in the Perithecia and Ascospores of certain *Erysipheæ*. By B. T. Galloway, Department of Agriculture, Washington, D. C.

6. The *Erysipheæ* of North America: A preliminary account of the distribution of the species. By B. T. Galloway, Department of Agriculture, Washington, D. C.

7. Some Contributions to the Life-History of *Hæmatococcus*. By Professor L. R. Jones, University of Vermont, Burlington, Vermont.

8. 'Bacteriosis' of Carnations. By Albert F. Woods, Department of Agriculture, Washington, D. C.

9. Wakker's Hyacinth *Bacterium*. By Dr. Erwin F. Smith, Department of Agriculture, Washington, D. C.

10. Notes on some new genera of Fungi. By Professor George F. Atkinson, Cornell University, Ithaca, N. Y.

11. Reproductive Organs and Embryology of *Drosera*. By C. A. Peters, Normal School, Edinboro, Penn.

12. Development of some seed coats. By Dr. J. O. Schlotterbeck, University of Michigan, Ann Arbor, Mich.

13. Morphology of the Flower of *Asclepias cornuti*. By Fanny E. Langdon. Reported by Professor V. M. Spalding, University of Michigan, Ann Arbor, Mich.

14. Comparison of the Pollen of *Pinus*, *Taxus* and *Peltandra*. By Professor George F. Atkinson, Cornell University, Ithaca, N. Y.

15. Report upon the Progress of the Botanical Survey of Nebraska. By Professor Charles E. Bessey, University of Nebraska, Lincoln, Neb.

16. Are the Trees receding from the Nebraska Plains? By Professor Charles E. Bessey, University of Nebraska, Lincoln, Neb.

17. Some Characteristics of the Foothill Vegetation of western Nebraska. By Professor Charles E. Bessey, University of Nebraska, Lincoln, Neb.

18. On the Distribution of Starch in Woody Stems. Ry Professor Bohumil Shimek, University of Iowa, Iowa City, Iowa.

19. Mechanism of Root Curvature. By Dr. J. B. Pollock. Reported by Professor V. M. Spalding, University of Michigan, Ann Arbor, Mich.

20. The Toxic Action of Phenols on Plants. By Professor R. H. True and C. G. Hunkel, University of Wisconsin, Madison, Wis.

21. Cellulose-Ferment. By Professor F. C. Newcombe, University of Michigan, Ann Arbor, Mich.

22. Is the characteristic Acridity of certain species of the Arum Family a mechanical or a physiological property or effect? Chas. Porter Hart, M.D., Wyoming, Ohio.

23. How Plants flee from their Enemies. By Professor W. J. Beal, Michigan Agricultural College, Agricultural College P. O., Mich.

24. Movements of *Phyllanthus*. By Professor D. T. McDougal, University of Minnesota, Minneapolis, Minn.

25. Stomata on the Bud-scales of *Abies pectinata*. By Dr. Alex. P. Anderson, Exp. Station, Clemson College P. O., S. Carolina.

26. Comparative Anatomy of the Normal and Diseased Organs of *Abies balsamea* (L.) Miller, affected with *Aecidium elatinum* (Alb. et Schwein.). By Dr. Alex. P. Anderson, Exp. Station, Clemson College P. O., S. Carolina.

F. C. NEWCOMBE,
Secretary of the Section.

UNIVERSITY OF MICHIGAN.

SECTION H.—ANTHROPOLOGY.

Address of the Vice-President: The Science of Humanity. By Professor W J McGee, Bureau of American Ethnology, Washington, D. C.

1. The Rite of Adoption as practiced by the Osage Tribe. By Alice C. Fletcher, Peabody Museum, Cambridge, Mass.

2. The Superstitious Beliefs and Practices of the Ancient Mexicans. By Zelia Nuttall, Peabody Museum, Cambridge, Mass.

3. Koreshanity: a Latter-day Cult. By Dr. Anita Newcomb McGee, Washington, D. C.

4. Micmac Mortuary Customs. By Dr. Stansbury Hagar, Brooklyn, N. Y.

5. Report of the Committee on the Ethnography of the White Race in America. By Dr. Daniel G. Brinton, Chairman, Media, Pa.

6. Recent Researches by George Byron Gordon, on Ulloa River, Honduras. By Professor F. W. Putnam, Peabody Museum, Cambridge, Mass.

7. Surveys of Ancient Cities in Mexico. By Professor W. H. Holmes, Field Columbian Museum, Chicago.

8. An Ancient Figure of Terra-Cotta from the Valley of Mexico. By M. H. Saville, Amer. Mus. Nat. History, New York.

9. The Serpent Symbol in Nicaragua and Yucatan. By Rev. Stephen D. Peet, Good Hope, Illinois.

10. A Case of Trephining in Northeastern

Mexico. By Dr. Carl Lumholz, Amer. Mus. Nat. History, New York.

11. Notched Human Bones from a Prehistoric Tarascan Tomb in Michoacan. By Dr. Carl Lumholz and Dr. A. Hrdlicka, New York.

12. A Cranium and Skeleton from an Ancient Burial Place in the Valley of Mexico. By Dr. A. Hrdlicka, New York.

13. An Archæologic Map of Ohio. By Warren K. Moorehead, Ohio State University, Columbus, Ohio.

14. Early Man of the Delaware Valley. By Professor F. W. Putnam, Peabody Museum, Cambridge, Mass.

15. Archæologic Researches in the Trenton Gravels. By Professor W. H. Holmes, Field Columbian Museum, Chicago.

16. Geologic Age of the Relic-bearing Deposits at Trenton. By Professor R. D. Salisbury, Chicago University, Chicago.

17. Prehistoric Implements from Charlevoix, Michigan. By H. P. Parmalee, Charlevoix, Mich.

18. Decoration of the Teeth in Ancient America. By M. H. Saville, American Museum Natural History, New York.

19. The Origin of Art as manifested in the Work of Prehistoric Man. By Dr. Thomas Wilson.

20. The Import of the Totem—A Study of the Omaha Tribe. By Alice C. Fletcher, Washington, D. C.

21. The Jessup Expedition and the Asiatic-American Problem. By Professor F. W. Putnam, Americam Museum Nat. Hist., New York.

22. Evidence of contact with Polynesia and the Asiatic Coast. By Rev. Stephen D. Peet, Good Hope, Ill.

23. The Ethnologic Arrangement of Archæologic Material. By Harlan I. Smith, American Museum Nat. Hist., New York.

24. The Tagbanna of the Philippines. By Dean C. Worcester, Ann Arbor, Mich.

25. The Mangyane of the Philippines. By Dean C. Worcester, Ann Arbor, Mich.

26. The Artificialization of Animals and Plants. By Professor O. T. Mason, National Museum, Washington, D. C.

27. Report of Committee on Anthropologic Teaching.

28. A Statistical Study of Eminent Men. By Professor J. McKeen Cattell, Columbia University, New York.

29. Mental Conditions determining the Rate of Movement. By Professor Lightner Witmer, University of Pennsylvania, Philadelphia.

30. Genesis of Implement-making. By Frank Hamilton Cushing, Bureau of American Ethnology, Washington, D. C.

SECTION I.—SOCIAL AND ECONOMIC SCIENCE.

Address of the Vice-President: Improvident Civilization. By Mr. R. T. Colburn, Elizabeth, N. J.

Beginning on Tuesday, August 10th, the following papers will be read;

1. The Civil Service Reform. By Dr. Wm. H. Hale, Brooklyn, N. Y.

2. Civic Ownership of Public Works. By Dr. Wm. H. Hale, Brooklyn, N. Y.

3. Racial Deterioration: the Increase of Suicide. By Lawrence Irwell, Buffalo, N. Y.

4. Wheat Consumption in the United States. By Henry Farquhar, Dep't of Agriculture, Washington, D. C.

5. The Municipal System of Ontario. By C. C. James, M.A., Toronto.

6. The New Canadian Tariff. By Professor James Mavor, Toronto.

7. Suggestions for an International Conference on Diversity of Languages. By R. T. Colburn, Elizabeth, N. J.

8. The 'Social Mind,' or 'Social Conscience;' its origin and persistence. By ———.

9. Tariffs and Trade. By Archibald Blue, Bureau of Mines, Toronto.

10. The Course of Ontario Agriculture durthe past ten years. By C. C. James, M.A., Toronto.

11. The U. S. idea in laying out the Public Lands and the Evils resulting therefrom. By B. W. DeCourcy, Tacoma, Wash.

12. Labor Restrictions as Potent Factors in Social Evolution. By Dr. Charles Porter Hart, Wyoming, Ohio.

13. International currency. By H. P. V. Bogne, Avon, N. Y.

ARCHIBALD BLUE,
Secretary of the Section.

BUREAU OF MINES, TORONTO.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. McKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, AUGUST 13, 1897.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*EDWARD DRINKER COPE, NATURALIST—A CHAPTER IN THE HISTORY OF SCIENCE.**

I.

Bitter constraint, and sad occasion dear
Compels me to disturb your season due;
For Lycidas is dead, dead ere his time
Our Lycidas, and hath not left his peer.

ON the morning of the 13th of April, in a car on my way from a funeral in New York to Washington, a newspaper notice of the death, the day before, of my old friend, E. D. Cope, caught my eye. Shocked by the intelligence, I dropped the paper, and memory recalled various incidents of our long acquaintance.

The threnody of Milton* in commemoration of his friend Edward King also rose to recollection, and the lines just quoted seemed to me to be peculiarly fitted for the great man just dead. He was, indeed, no longer young and had attained his prime,† but he had planned work for many years to come and had well advanced in the execution of some of it. He had truly died before his time and had left no peer; the greatest of the long line of American naturalists was prematurely snatched from science and from friends.

My acquaintance with Cope began in 1859. While looking through the part of the Proceedings of the Academy of Natural Sciences of Philadelphia for the month of April, in which my first paper published by the Academy had appeared, I found one by E. D. Cope 'On the primary divisions of the Salamandridæ.' It seems that the papers by Cope and myself had been passed on by the Committee on Publications on the very same day (April 26th) and appeared in print in juxtaposition. I had not previously

* Address by the retiring President of the American Association for the Advancement of Science at the Detroit Meeting, August 9th.

* Milton, Poems XVII.

† In the extract from Milton's poem, *time* has been substituted for *prime* and *our* for *young*.

heard of the new devotee of science and read his article with as much interest as my own. A well-equipped man had evidently come upon the field and this was the first of the numerous articles that were destined to appear in an uninterrupted flow for nearly four decades. A few months afterwards I met the author in Philadelphia at the Academy. A young man, nineteen years old, about 5 feet 9 or 10 inches high, with head carried somewhat backwards and of rather robust frame, stood before me; he had an alert, energetic manner, a pronounced, positive voice, and appeared to be well able to take his part in any trouble. His knowledge was by no means confined to herpetology, but covered a wide range of science, and his preliminary education had been good. We afterwards met from time to time in Philadelphia and Washington and found we had many sympathies in common and some differences.

In one of our first interviews we had quite an argument on the nature of the family group in zoology, resulting from criticisms I made on the extended scope he had given to that category in the classification of the Salamanders. Another controversy, I remember, had reference to the vertebral theory of the skull. In an article on the venomous serpents, published in the Proceedings of the Academy for 1859, he had defined the group in terms involving the adoption of that theory, and I ventured to dissent from its reality. I had myself been much impressed with it in former days and when 16 years old had copied in colors an illustration of Owen's so-called archetype reproduced in Carpenter's Physiology. Subsequently, however, the fact that there was only an approximation to the realization of it in the most specialized of fishes and not at all among the lower or higher vertebrates, with other considerations, turned me from it, and I gave my reasons for dissent to Cope. Ultimately he admitted the force of the argument and also abandoned the theory at one time so popular in England and America.

Our acquaintance, thus begun in 1859, continued uninterruptedly till death divided us. We rarely met, indeed, that we did not express difference of opinion respecting some subject, but the difference was never of a serious nature and generally little more than sufficient to enliven intercourse.

II.

The future naturalist was born in Philadelphia on the 28th of July, 1840, and the name Edward Drinker was given to him. He was the descendant of a prosperous line long established in Pennsylvania. His father, Alfred, was a man of cultivated literary taste and did much to train his son's mind in early youth. He had retired from active business and lived in luxurious ease in Germantown, a suburb of Philadelphia. There he had formed an arboretum containing most of the American trees which would thrive in the climate of that region. Amidst such surroundings the youthful Cope grew up.

An active and intelligent interest in Nature became manifest at a very early age. When only about seven years old, during a sea voyage to Boston with his father, the boy is said to have kept a journal which he filled with drawings of 'jelly fish, grampuses and other natural objects seen by the way.' When eight and a half years old he made his first visit to the Museum of the Academy of Natural Sciences of his native city; this visit was on the "21st day of the 10th Month, 1848," as entered in his journal. He brought away careful drawings, measurements and descriptions of several larger birds, as well as of the skeleton of an Ichthyosaurus. His drawing of the fossil reptile bears the explanatory legend in Quaker style: "two of the sclerotic plates look at the eye—thee will see these in it."

At the age of ten he was taken upon a voyage to the West Indies.* What were the impressions he derived from that voyage we have not been told. But what has been communicated amply justified Professor Osborn in his declaration that "the principal impression he gave in boyhood was of incessant activity in mind and body, reaching in every direction for knowledge, and of great independence in character and action." His school education was mostly carried on in the Westtown Academy, a Quaker institution about 23 miles west of Philadelphia. One of his instructers was Dr. Joseph Thomas, a well known literary worker of Philadelphia and future author of a 'Universal Pronouncing Dictionary of Biography and Mythology' (1870), and said to be an 'excellent linguist.' Under his guidance Cope obtained a passing knowledge of Latin and Greek. He appeared to have had no instruction in any biological science and had no regular collegiate training. He did, however, enjoy the advantage of "a year's study (1858–9) of anatomy and clinical instruction at the University of Pennsylvania," in which the illustrious Leidy was professor of anatomy. But, in the words of his literary executor (Professor H. F. Osborn), "it is evident that he owed far more to paternal guidance in the direct study of nature and to his own impulses as a young investigator than to the five or six years of formal education which he received at school. He was especially fond of map drawing and of geographical studies."

While a school boy he relieved his studies of the classics and the regular course in which boys of his age were drilled by excursions into the fields and woods. Reptile life especially interested him, and he sought salamanders, snakes and tortoises under rocks, stones, fallen trees and layers of leaves, as well as in the ponds and streams of his vicinage. The trophies of his excursions were identified from descriptions in the works in which they were treated, as well as by comparison with identified specimens in the museum of the Academy. He early and almost without guidance learned to use the library and collection of the Academy, although he did not become a member until he came of age in 1861.

*Osborn in Science, n. s., V., 706.

Cope's first contribution to the Proceedings of the Academy appeared in the part covering April and was 'On the Primary Divisions of the Salamandridæ, with descriptions of the New Species.'* In this maiden paper he instituted important modifications of the systems previously adopted in the United States. He soon afterwards catalogued the serpents preserved in the museum of the Academy of Natural Sciences and likewise improved upon the systems previously in vogue. He continued with various papers, describing new species and giving synopses or brief monographs of sundry genera of lizards and anurous amphibians.

For five years his publication was confined almost exclusively to the reptiles and amphibians. (The continuity was only interrupted once in 1862, when he described a new shrew caught by himself in New Hampshire.) Not until 1864 did he begin to extend his field. In that year he described various fishes and a supposed new whale, and gave his first contribution to paleontology in the description of the stegosaurian amphibian called *Amphibamus grandiceps*. But although his attention had become thus divided, he never lost his interest in herpetology and continued to the end of his life to devote much attention to that department. His studies extended to every branch of the subject, covering not only specific details and general taxonomy, but also the consideration of anatomical details, the modifications of different organs, geographical distribution,

*Proc. Acad. Nat. Sci. Phila., 1859, pp. 122–128.

chronological sequence, genetic relations and physiological consequences. So numerous were his memoirs, so entirely did he cover the field of herpetology, and so marked an impression did he make on the science, that he was well entitled to apply to himself the boast of the Vergilian hero, '*Pars magna fui.*'

In his earliest essays he manifested the independence and critical spirit which were so characteristic of him later. One knowing all the circumstances of the case may be amused in coming across a passage expressed in the tones of a veteran published by him when 20 years old: "In proposing the name Zaocys * * * we are giving expression to an opinion *long held by us* as to the unnatural association of species in the so-called genus *Coryphodon* * * *. In it we find cylindrical terrestrial species united with compressed subarboricole species, upon a peculiarity whose value as an index of nature appears to us entirely imaginary. The very nature of the *coryphodontian* type of dentition, as distinguished from the *isodontian* and *syncranterian*, would lead us to infer its inconstancy;" and so on.* Bold as was the criticism of such herpetologists as Duméril, Bibron and Günther, it was justified by the facts, and the young author's conclusions have received the endorsement of the best succeeding herpetologists, including even the latest author criticised.

In 1863 he paid a visit to Europe, partly for the benefit of his health which had suffered from overwork, and partly for the purpose of seeing the great museums of England, France, Holland, Austria and Prussia. Notwithstanding his ailments, he made good use of his time abroad and systematically examined the collections of reptiles in the chief centers of science. He did not even restrict his studies to herpetology, but extended them to various other subjects.

*Proc. Acad. Nat. Sci., Phila., 1860, p. 563.

On his return from Europe, in 1864, he was appointed professor of natural science in Haverford College, an institution chiefly supported by Quakers, but retained the position only three years. During this time, in 1865, he married Miss Annie, daughter of Mr. Andrew Pim, of Chester county, Pa.

In and after 1864, too, he enlarged the range of his studies and publications and also extended them to ichthyology, mammalogy and paleontology. He had always been interested in the philosophical aspects of science and early adopted the conception of descent with modifications to account for the variations of animals and the differentiation into species and higher groups, and in 1869 began to give expression to his peculiar views.

On the death of his father he became heir to a considerable fortune. Part of this was invested in mines which for a short time gave promise of good returns, but, it is said, the majority of the stock was held by others, and owing to the incapacity of superintendents and the operations of the controlling stockholders he lost his interests. While in the enjoyment of his fortune he spent large amounts in collections and personally conducted or sent out expeditions to various places. One of the most important was sent to South America. He filled a large house from cellar to topmost story with his collections and resided in an adjoining one.

In 1871 he conducted an expedition to Kansas and especially investigated the Cretaceous beds of that State and collected their fossils. In 1872 and 1873 he became connected with the U. S. Geological Survey and for the fossils visited Wyoming in the former year and Colorado in the latter. In 1874 he joined the survey under the command of Lieut. Wheeler, of the Engineers, and explored New Mexico.

The collections made during these expeditions were large and the unwearied in-

dustry and energy, as well as cares, of Cope were rewarded with many well-preserved fossils. These were described in many communications to the Academy of Natural Sciences and the American Philosophical Society, and later in large volumes published by the general government as reports of the respective surveys with which he was connected.

The various investigations thus opened were continued through the succeeding years. His collections continued to grow in spite of reduced means. He refused even to sell portions for which he was offered liberal sums and, at the cost of personal discomfort, held on to them and made his home, for much of the time, in the midst of them, having sold his residential house but kept his museum.

In 1878 he purchased the rights of the proprietors of the *American Naturalist* and removed it to Philadelphia. Professor Packard, one of the original proprietors, cooperated with him in the editing of it for some years, and he was also assisted by various eminent specialists. In this journal numerous articles of all kinds, including reviews and editorial comments, were published by him. His last words appeared in numbers issued after his death, the leading article in the number for June having been written shortly before his death ; it treats of the remarkable mammals of South America, known as Toxodontia.

In 1886 he received an appointment to a chair in the University of Pennsylvania and became professor of geology and paleontology. Such a man naturally awakened the interest of apt pupils, and he was a facile and entertaining lecturer. From the stores of a rich memory he could improvise a discourse on almost any topic within the range of his varied studies. His views were so much in advance of those in any text-book that for his own convenience, no less than for the benefit of his pupils, he felt compelled to prepare a 'Syllabus of lectures on geology and paleontology,' but only 'Part III., Paleontology of the Vertebrata,' was published. It appeared in 1891 and is still a valuable epitome of the classification of the vertebrates, recent as well as fossil, giving in dichotomous tables the essential characters of all the groups above families and also the names of all the families. His own industry and investigations did much to render this antiquated in even six years and a new edition or work became necessary. "Upon the Tuesday preceding his death he sent to the press an elaborate outline of his University lectures containing his latest ideas of the classification of the Vertebrata."*

The enormous mass of publications constantly flowing from his own pen might lead one unacquainted with the author to suppose that he was probably a recluse, but there were few men of his intellectuality who were less disposed to seclude themselves. He enjoyed and gave enjoyment to intellectual company and was a brilliant conversationalist. He was especially fond of academical meetings and was an unusually frequent attendant at the meetings of the American Association as well as of the National Academy of Sciences. His election to the Presidency of the American Association was highly esteemed by him and doubtless his address would have been a notable one.

In February (1897) Cope's health became seriously affected by nephritic disorder, which, it is said, 'might possibly have been remedied by a surgical operation,' but this he would not submit to. Notwithstanding failing health, he continued active almost to the last. Finally the insidious disease invaded his entire system and he died on the 12th of April, in the room he had long used as a study, surrounded by the objects of his life-long attentions.

* Osborn in SCIENCE, May 7, p. 705.

Such were the chief episodes of Cope's individual life; the facts known are few and the record belongs rather to his family than to us. But Cope's real life was in his work and to the consideration of that work we may now proceed. Let us adopt the order in which he took up the subjects of his investigations and successively look into his contributions to herpetology (III), ichthyology (IV), mammalogy (V) and paleontology (VI); we may then examine his philosophical views and especially those relating to evolution (VII); finally we may attempt to forecast the position he is destined to enjoy in the history of science (VIII). To know him as he was we must recognize his weakness as well as his strength. He himself has wished this and has asked in the spirit of the Moor:

> Speak of me as I am; nothing extenuate,
> Nor set down aught in malice.

III.

The extent of Cope's contributions to herpetology have been referred to. Herpetology was his first love and continued to be the favorite branch of science to his life's end. His impress on it was, in some respects at least, greater than on any other of the sciences he cultivated, and doubtless the systems he introduced, with some modifications, will be the most lasting. He found herpetology an art; he left it a science; he found it a device mainly for the naming of specimens; he left it the expression of the coordination of all structural features. The reformations he effected in the classification of the anurous amphibians and the saurian reptiles were especially notable.

The anurans had been chiefly differentiated in groups on account of the most superficial characters. Such were the modes of fixation of the tongue or its absence, the development of disk-like expansions of the tips of the toes, or simply attenuated toes, and the presence or absence of teeth in a jaw. Cope proceeded to investigate the group in an anatomical manner and reached entirely new conclusions. He found that important differences existed in the structure of the sternum, and especially in the connection of the lateral halves. In the common toads and tree toads of Europe and North America the so-called clavicle and coracoid of each side are 'connected by a longitudinal arched cartilage which overlaps that of the opposite side,' while in the common frogs the clavicles and coracoids of both sides are connected by a single median cartilage. The former type is now known as the arciferous and the latter as the firmisternal. Although Cope was the first to appreciate the significance of those characters, he did not at once fully realize their morphological value, the name Arcifera having been originally applied by him only to types of that group having teeth. Ultimately he did so, and his views have stood the test of time and the latest critical investigations. He also found that the characters so revealed served to fix the places in the system of the groups in question. In their early stages the Firmisternials (or frogs and their relations) have the shoulder-girdle movable, and thus resemble the Arcifers (toads, etc.), which have the opposite halves movable during their whole lifetime; thus it became evident that the latter are the lowest or most generalized forms, and the former more advanced and higher in the system. The development of teeth, which had been supposed by the earlier systematists to be of paramount value, and which Cope, following in their footsteps, had also originally unduly valued, has been found to be of quite subordinate importance.

The lizards were also in former times distributed into families and other groups on account of variations in superficial or external characters, such as the form of the tongue, the arrangement of the scales and the development of legs and feet. Cope

dissected examples of all the types he could obtain and found that such superficial characters were often misleading, and he proceeded to arrange them with reference to the preponderance of all characters. The structure of the cranium especially was analyzed, and the variations and concordances in the development of various bones were tabulated. These characters were supplemented by others derived from the vertebræ, the shoulder girdle, the teeth, the tongue and the pholidosis. Familiarity with his subject enabled him almost instinctively to assess the relative values of the different characters, and he obtained fitting equations which resulted in a system which has received the approbation of the most competent judges to the present time.

The extent of Cope's influence on herpetology may be to some extent inferred from the catalogues of the richest collection of reptiles and amphibians in existence—the British Museum's. Descriptive catalogues of both the Anurans and Saurians have been published at different times. In the early catalogues are adopted the views current at the dates of publication—1845 for the lizards; 1858 for the batrachians. New editions were published many years later and the systems of Cope were adopted with slight modifications. In his catalogue of the *Batrachia salientia* Mr. Boulenger, the author, remarked that it appeared "undeniable that the principles of classification laid down by Mr. Cope are more in accordance with the natural affinities of the genera of tailless Batrachians than those employed by other authors; this is amply proved by all we know of their geographical distribution, development and physiology."

In an article* published in advance of his catalogue of the lizards, Boulenger states that the old classifications are, 'on the whole, as unnatural as can be' and that, "like Cope, whose lizard families I regard as the most natural hitherto proposed, I shall lay greater stress on osteological characters and on the structure of the tongue."

*Synopsis of the families of existing Lacertilia. Ann. and Mag. Nat. Hist. (5), XIV., 117.

It was a long time, however, before Cope's views became popular. Even anatomists of repute refused to follow him. One* of them, for example, admitted that "skeletal characters are, indeed, most valuable ones in leading us to detect the deepest and truest affinities of vertebrate animals, but [he urged] these affinities once found, it is very desirable that zoological classification should not, if it can possibly be avoided, *repose* upon them only, but rather on more external and more readily ascertainable characters." He, therefore, ventured 'to propose a classification derived from that of Dr. Günther.'

Cope replied† by a fierce review of the work of Dr. Günther, and concluded with the utterance that such views 'will only interfere with the progress of knowledge if sincerely held and believed.'

But such views were evidently sincerely believed and they did retard the progress of science. An eminent Russian herpetologist objected to the use of anatomical characters. He especially protested against those employed by Boulenger after Cope to the grouping of the lizards, and Mr. Boulenger considered it incumbent on him to defend the practice of using such characters; ‡ he aptly replied that the use of 'purely external characters * * * does not meet the requirements of modern science,' and that classifications are not made simply 'for the convenience of beginners.'

At last, however, the principles of classification adopted by Cope have become gen-

*Mivart in Proc. Zool, Soc., London, 1869, p. 281.

†Cope in Am. Journ. Sci. (3), I., p. 203.

‡Boulenger in Ann. and Mag. Nat. Hist. (5), XIX. 385.

erally accepted, and doubtless this was in no small degree hastened by their application to all the amphibians and reptiles by Boulenger.

Cope's attention to the extinct reptiles was excited by the examination and consideration of a Carboniferous lizard-like amphibian which he was requested in 1865 to report upon. It was a new species which he named *Amphibamus grandiceps* and considered to be the type of a new order to which the name Xenorachia was applied, but which he subsequently referred to the new comprehensive order Stegocephali.

He sought for specimens of the extinct species with as much enthusiasm as he had for the recent. Extinct and living he considered together and light was mutually reflected from the two to guide him in the perfection of the entire system. In 1869 he gave expression to the results of his studies in a well illustrated 'Synopsis of the Extinct Batrachia, Reptilia and Aves of North America.' This was supplemented in 1874 by addenda and a 'Catalogue of the air-breathing Vertebrata from the coal measures of Ohio.'

A rich field was opened to him in 1877, when he received the first instalment of reptilian remains from Texas, which were at first considered to be of Triassic age, but subsequently determined to be Permian. Successive instalments of amphibian as well as reptilian skeletons enriched his collection, and his investigations revealed a new and wonderful fauna rich in species and often differing widely from any previously known. These were described in many articles. The results for the amphibians were summarized in 1884 in a memoir on the 'Batrachia of the Permian period of North America.'

The Permian amphibians were found to vary much in the composition of their backbones. Instead of having single centra arranged in a continuous row as in existing Vertebrates, they had distinct bones on which were devolved portions of the functions fulfilled by the centra of higher Vertebrates. Some had 'the vertebral bodies represented by three segments each, a basal intercentrum and two lateral pleurocentra;' these were named 'Ganocephali' and 'Rhachitomi.' Some "differ remarkably from all other Vertebrata in having between the centra another set of vertebral bodies, so that each arch has two corresponding bodies;" these were called 'Embolomeri.'

In tracing the development of these bones, Cope came to the conclusion that they were only partially represented in higher or more specialized types; they did not become consolidated, but one or the other became reduced and finally lost or at least greatly atrophied. In the living amphibians the vertebral centra are homologous only with the intercentra, while, on the contrary, the centra of the reptiles, birds and mammals are represented by the pleurocentra of the Rhachitomes.

The studies of Cope on those classes which had earliest attracted his attention were more nearly completed than for any others. Many years ago he had contemplated the publication of monographs of the amphibians and reptiles of North America and happily he had at last finished his work.

In 1889 his monograph of the 'Batrachia of North America' was given to the world as a Bulletin of the United States National Museum (No. 34). It forms a goodly volume of 525 pages illustrated by 86* plates and 120 figures inserted in the text. No large country has a more elaborate and scientific exposition of the class than is given in this volume. A synopsis is furnished of all the families and genera wherever found, and detailed descriptions are supplied for all the groups and species

* The last plate is numbered 86, but five were cancelled, 80, 81, 82, 84 and 85.

represented in the zoological realm of North America, 31 genera and 107 species are recognized, and of these Cope had first made known about a quarter, 7 of the genera and 27 of the species having been described by himself. Shortly before his death, and during his last visit to Washington he delivered to the National Museum the report on all the reptiles of North America which he had been long preparing. This was prepared on the model of his 'Batrachia of North America,' but will, of course, be a much larger work, inasmuch as there are nearly three times as many reptiles as Batrachians.* His last elaborate memoirs dealt with special anatomical features of the serpents and lizards, which he examined with the view of perfecting the system of those groups.

IV.

In 1864 he became especially interested in the fresh-water fishes of the United States, and then as well as in succeeding years published enumerations and descriptions of many species. His first papers in 1864 and 1865 were 'On a blind Silurid from Pennsylvania' and a 'Partial catalogue of the cold-blooded Vertebrata of Michigan;' in 1868 he published 'On the distribution of fresh-water fishes in the Allegheny region of southwestern Virginia,' and in 1869 appeared a 'Synopsis of the Cyprinidæ of Pennsylvania.' In addition to these, various minor papers were published and in some of them marine forms were considered.

When in Europe Cope had purchased a large collection of skeletons of fishes from all parts of the world prepared by Professor Joseph Hyrtl, of Vienna, one of the most skillful practical anatomists of the day. He had a number of other skeletons made to represent missing types. With these as a basis he proceeded to recast the classification of fishes. The first contribution to the subject was embodied in an introductory chapter of his 'Contribution to the Ichthyology of the Lesser Antilles,' published early in 1871.

The same chapter, with the same title, 'Observations on the Systematic Relations of Fishes,' but with some modifications and additions, was later published in the Proceedings of the American Association for the Advancement of Science for 1871. This was a notable paper and replete with original observations of value. It was not, however, up to the standard of his work on amphibians and reptiles. The subject, indeed, was too vast and only a superficial examination was made of special parts. It was not a classification based on the examination of the entire structure, but rather an exposition of the development of a few particular characters, which more experience subsequently convinced him were of less value than he had supposed. Nevertheless, in some respects the proposed classification was much in advance of those previously adopted, and useful hints were given for the further improvement of the system.

Later Cope followed up this attempt at the reformation of the ichthyological system with several others especially treating of extinct types. One of them, 'On the classification of the extinct fishes of the lower types,' was published in the Proceedings of the American Association for 1877. The results of his studies were summarized, in 1889, in 'A synopsis of the families of Vertebrata,' and two years afterwards (1891) with modifications, in an article 'On the non-actinopterygian Teleostomi.' These results were very valuable and attention was for the first time directed to the importance and morphological significance of the skeletal fin structures of the ancient fishes long confounded under the name of Gan-

* Cope's monograph of the reptiles will not include the tortoises, those having been left to Dr. G. Baur to monograph.

oids. Instead of this single order (or subclass) of the old systematists, he named four superorders of the Teleostomi or true fishes,' and recognized seven orders, including the old ganoids after eliminating the Lepidosteids and Amiids, which were referred to the Actinopterygians. Only two of the seven orders are represented by existing forms—one (*Cladistia*) by the bichirs of Africa and the other (*Chondrostei*) by the sturgeons.

His work on the extinct fishes was incomparably better than any that had been done before in the United States. He far surpassed all his predecessors, not only by his knowledge of morphological details manifest in the extinct as well as living forms, but by his keen philosophical instinct and taxonomic tact. But this philosophical instinct was sometimes at fault, and occasionally he indulged in the wildest speculations, for which he has, not unjustly, been taken to task. But even his blunders were the result of the facility of his mind in seizing and adapting the latest utterances of science. One notorious case may be given. The great Russian embryologist Kowalevsky published a memoir sustaining the thesis that the Tunicates were members of the vertebrate phylum and that the larval stage of most of the species had the homological equivalent of the backbone of the true vertebrates. Cope foresaw the morphological consequences of this view and sought the vertebrates nearest the Tunicates. He settled upon some strange forms of the Silurian and Devonian times known as Pteraspids and Cephalaspids. They were the earliest known of vertebrates and therefore likely to be the most primitive in structure. Most of them had a shell-like encasement, composed of bone-like plates. He happened to find illustrations of the living *Chelyosoma*, a true Tunicate having a system of plate-like indurations of the integument, somewhat similar in appearance to those of some of the ancient fishes. It was assumed that this mere superficial similarity indicated genetic relationship. To those acquainted with the structure of *Chelyosoma* this approximation seemed strange indeed; its anatomy was known and the form is simply a well marked relation of the typical ascidiids, but highly specialized by the development of integumentary plate-like horny indurations. Histologically and otherwise they were very different from the plates of the extinct armored vertebrates. Cope's guess was simply the result of the tendency to jump at conclusions which he was constantly obliged to curb, and unfortunately he rushed into print before he had time to think. He soon reconsidered the case with calmer mind, and abandoned his hypothesis. Few men were ever more willing to reconsider evidence and retrace false steps than he.

In spite of errors of detail and somewhat hasty generalization the ichthyological labors of Cope were unusually valuable contributions to science, and the progress of ichthyology has been much accelerated, not only by these labors, but by the investigations they challenged.

V.

Cope's attention was early drawn to the mammals. His first published article (1863) was a description of a supposed new Shrew found in New Hampshire, and in 1865 he described various cetaceans. In 1868 he began the collection and investigation of the fossil mammals of the western territory, and thenceforward devoted the larger share of his attention to the description and restoration of the numerous new species which he from time to time brought to light. The previous investigators of the extinct mammals of America had almost exclusively confined themselves to descriptions and illustrations of the crania and dentition, but a new era was intro-

duced when Marsh and Cope sent out exploring expeditions or themselves collected. No parts of skeleton were neglected; all were collected. Gradually the numerous bones from different parts of the skeleton were identified, and finally many of the beasts of old were resurrected into skeletons almost as complete as those just divested of muscles.

The discoveries resulting from such thorough work quite modified or even overturned old conceptions. It became evident that there was a great contrast between the development of the mammals and that of invertebrates, and even, though in a less degree, of fishes. It appeared that there was a much more rapid process of evolution for the mammals than for the lower classes. All the mammals of the oldest of the Tertiary periods were strange and very unlike those of recent times, and no descendants of even the same families lived to be the contemporaries of civilized man. The views of the founder of vertebrate paleontology were also to a considerable extent subverted. Cuvier taught that there was always a coordination between the various systems of the animal frame and that from the remains or impress of one part the approximate structure of the other parts could be inferred. He even pushed this doctrine to such an extreme that he overlooked some obvious counter-facts. One such case is so remarkable because it orginated with Cuvier and was endorsed by Huxley* that it is worthy of mention here, and Huxley's introduction to it and translation of it may be given. Huxley himself protests against the too literal application of Cuvier's law and recalls Cuvier's own reserve:

"Cuvier, the more servile of whose imitators are fond of citing his mistaken doctrines as to the nature of the methods of paleontology against the conclusions of logic and of common sense, has put this so strongly that I cannot refrain from quoting his words.*

"But I doubt if any one would have divined, if untaught by observation, that all ruminants have the foot cleft, and that they alone have it. I doubt if any one would have divined that there are frontal horns only in this class; that those among them which have sharp canines for the most part lack horns.

"However, since these relations are constant, they must have some sufficient cause; but since we are ignorant of it, we must make good the defect of the theory by means of observation. It enables us to establish empirical laws, which become almost as certain as rational laws, when they rest on sufficiently repeated observations; so that now, whoso sees merely the print of a cleft foot may conclude that the animal which left this impression ruminated, and this conclusion is as certain as any other in physics or morals. This footprint alone, then, yields to him who observes it, the form of the teeth, the form of the jaws, the form of the vertebræ, the form of all the bones of the legs, of the thighs, of the shoulders, and of the pelvis of the animal which has passed by. It is a surer mark than all those of Zadig."

The first perusal of these remarks would occasion surprise to some and immediately induce a second, more careful reading to ascertain whether they had not been misunderstood. Some men, with much less knowledge than either Cuvier or Huxley, may at once recall living exceptions to the positive statements as to the coordination of the 'foot cleft' with the other characters specified. One of the most common of domesticated animals—the hog—would come up before the 'mind's eye,' if not the actual eye at the moment, to refute any such correlation as was claimed. Nevertheless, notwithstanding the fierce controversial literature centered on Huxley, no allusion appears to have been made to the lapsus. Yet every one will admit that the hog has the 'foot cleft' as much as any ruminant, but the 'form of the teeth' and the form of some vertebræ are quite different from those of the ruminants, and of course the multiple stomach and adaptation

*Huxley, 'Introduction to the Classification of Animals,' 1869, in first chapter 'On Classification in General.'

*Ossemens fossiles, ed, 4^{me}, tome, 1^{r}, p. 184.

for rumination do not exist in the hog. That any one mammalogist should make such a slip is not very surprising, but that a second equally learned should follow in his steps is a singular psychological curiosity.

I need scarcely add that the law of correlation applied by Cuvier to the structures of ruminants entirely fails in the case of many extinct mammals discovered since Cuvier's days. Zadig would have been completely nonplussed if he could have seen the imprint of an Agriochœrid, a Unitatherid or a Menodontid.

I have given this quotation for two reasons: first, to indicate how the increase of our knowledge has revolutionized old conceptions; and second, to show how even the ablest of men may stumble.

Cope has been much criticised for the mistakes and false generalizations he made. Unquestionably he did make many. But error seems to be inseparable from investigation, and if he made more than the other great masters he covered more ground and did more work. He was also, it must be admitted, more hasty than some others in that he availed himself of the more frequent means of publication he enjoyed.

The great merit of Cope's work on mammals is that he always considered the old and new—the extinct and recent—forms together. He refused to be bound by consistency or by precedent, either set by himself or others. Fresh discoveries opened new vistas to him, and he modified his views from time to time and as often as he received new evidence.

He introduced many new families in the system and sought to improve the system by the comparison of all the elements of the skeleton. He came to the conclusion that the affinities of the ungulate quadrupeds was best expressed by the manner of articulation of the bones of the carpus and tarsus; he associated those having the 'carpal and usually tarsal bones in linear series' in a great order which he called Taxeopoda, and contrasted them with the Proboscidea and typical Ungulata, which he named anew Diplarthra. In the Taxeopoda he gathered many extinct families and associated with them forms of the existing fauna known as the Hyracoidea, Daubentonioidea, Quadrumana and Anthropomorpha. I cannot altogether assent to this collocation inasmuch as I think the common characteristics of the three groups last mentioned—especially the structure of the brain and the development of the posterior cornua of the ventricles as well as calcarine sulci—justify the old order Primates. Nevertheless an important character was first appreciated in the composition of the podial bones, and fresh insight was obtained into the relations of ancient types.

I can only name a few more of Cope's discoveries in this connection. One was the generalization of 'trituberculy,' or the original development of three tubercles to molar teeth, and that subsequent modifications of the corresponding teeth were based on this original plan. Another was the remarkable *Phenacodus* of the Eocene, which was considered to be nearly in the line of descent for the ungulates as well as the series culminating in man and which led him to the conception of the taxeopodous group.

The past history and genealogy of the Camels and their relations were likewise elucidated. In the present epoch only two nearly related types exist separated by half the globe—the true camels of central and northern Asia and the llamas of the Peruvian Andes. Cope revealed numerous species from various Tertiary beds and showed that the type was originally richly developed in America.

VI.

Paleontology from more than one point of view may be divided into Invertebrate and

Vertebrate. The subjects of the former are generally to be found in an approximately complete condition so far as the exterior is concerned, and early attracted the attention of investigators, often little familiar with recent zoology, and received names. The subjects of the latter—especially the higher types, as mammals, birds and reptiles—are rarely found, except in a fragmentary condition. Special knowledge of osteology, even to its minutest details, is requisite to successfully deal with such remains. Consequently the fossil vertebrates of the United States were neglected and left to the few who had cultivated the requisite knowledge to deal with them.

Another reason existed for the tardy attention to Vertebrate paleontology, which continued till nearly the last quarter of our present century in the United States. No deposits containing many fossil vertebrate remains had become known in the East. Zoologists interested in the past and in the genealogy of existing forms lamented the poverty of the United States, which contrasted with the richness of some parts of Europe. It was even thought that there was no hope of finding here such trophies of the past as the beds of the Paris Basin or those of Grecian Pikermi had yielded to European paleontologists. But all this was to be changed. Rumor had long before hinted that numerous skeletal remains could be found in certain parts of the wild West, but the information was very vague. Enough was known, however, to induce Professor Marsh to visit certain deposits he had heard of. In 1870 he explored an Eocene lake-basin in Wyoming, drained by the Green river, the main tributary of the Colorado, and therein found numerous bones belonging to almost all parts of the skeleton, of some remarkable gigantic mammals which he called Dinocerata. The results of this exploration interested Cope in the highest degree. He visited the same region in 1872, and thenceforth his attention to the Vertebrate paleontology of the Western States and Territories was never interrupted. An intense rivalry arose between Professor Marsh and himself which in time, it must be confessed, became very bitter. Nevertheless, as in most quarrels respecting facts, investigations were provoked by mutual recriminations which resulted in a more speedy accumulation of data and a more critical examination of those data than would have been likely under less perturbed conditions. Most of those data relate to morphological and anatomical considerations, and therefore belong rather to mammalogy and herpetology than to geology.

The relations of the ancient forms to each other in point of time; to those of other lands; and to those whose remains were embedded in other rocks, had necessarily to be investigated. The earliest conclusions of Cope were brought together and published in 1879 in a memoir on 'The Relations of the Horizons of Extinct Vertebrata of Europe and North America.'* He attempted therein to synchronize, or, rather, homotaxially correlate the various ancient fauna of North America and 'West Europe' from the 'Primordial' to the 'Pliocene.' Naturally the greater part of the memoir was devoted to the consideration of the Tertiary divisions; of these he admitted for the American form six primary divisions, and four of these were dichotomously subdivided for the time. Of the primary divisions three were referred to the Eocene, one (White River) to the Oligocene, one (Loup Fork) to the Miocene, and one to the Pliocene. The exposition thus made represents views not very different from those now held, although, of course, modifications in details have since been necessary.

The evolution of the various animal, and especially mammalian types, was also con-

*Bull. U. S. Survey Terr., V., 33-54.

tinually the subject of Cope's researches, and he attempted to trace the passage from those of the most ancient periods to those of later ones.

VII.

Cope was not satisfied with the study of morphological details or simple taxonomy. He aspired to know how animals came into existence; why they varied as they did, and what laws determined their being. His was an eminently philosophical mind, but at the same time with a decided tendency to metaphysical speculation. In one of his earliest papers he manifested this tendency and it persisted through life. It is with much hesitation that I venture to give an exposition of his most salient views, for I must confess I do not altogether like his philosophy and am able to subscribe to it only in part. I cannot but wish that one of his numerous disciples could have been chosen for this task. But I cannot pass it by, for it is the most characteristic feature of Cope's work and the one he most esteemed.

Cope began his public scientific career, it will be remembered, in the same year in which Darwin's long studies had fructified into his 'Origin of Species.'

As was quite natural with his keen instincts, Cope early adopted the doctrine of transmutation of species and recognized the truth that all the animals of the present epoch are descendants from those of past times with modifications which separate them as species, and eventually as representatives of genera, of families and orders differing from the earlier ones as we retrace the steps of Time farther and farther back. He was not, however, satisfied with Darwin's theory, and denied that natural selection was a sufficient factor for differentiation. He would not admit that animals were passive subjects and that the slight variations which were manifest in the progeny of species were sufficient to enable nature to select from and to fit for future conditions. He contended that the volition and endeavors of an animal had much to do with future progeny as well as its own brief life. In short, he claimed that characters acquired by animals through their own efforts or forced on them by various external agencies or accidents might be transmitted to their offspring. He further, first in a in a chapter in his 'Synopsis of the Cyprinidæ of Pennsylvania' outlined, and later, × in 'The Origin of Genera,' ~~he~~ elaborated, a peculiar theory characterized mainly by what he called (with Professor Hyatt) 'the law of *acceleration* and *retardation*' in development. Darwin complained that he could never understand this law, and Cope complained that Darwin had not stated his views correctly in an attempted abstract. I therefore give Cope's views, restated in his own language, summarizing them years afterwards. "The following doctrines," he he says, "were taught:"

"First, that the development of new characters has been accomplished by an *acceleration* or *retardation* in the growth of the parts changed. This was demonstrated by reference to a class of facts, some of which were new, which gave ground for the establishment of the new doctrine.

Second, that of *exact parallelism* between the adult of one individual or set of individuals and a transitional stage of one or more other individuals. This doctrine is distinct from that of inexact parallelism which had already been stated by von Baer. And that this law expresses the origin of genera and higher groups, because,

Third, they can only be distinguished *by single characters* when all their representatives come to be known.

Fourth, that genera and various other groups have descended, not from a single generalized genus, etc., of the same group, but from corresponding genera of one or more other groups. This was called the doctrine of *homologous groups*.

Fifth, the doctrine that these homologous groups belong to different geological periods, and,

Sixth, to different geographical areas, which, therefore, in some instances, are,

Seventh, related to each other in a successional way like the epochs of geological time.

× Tr. A.P.S. 13, 399, 186

"Of these doctrines it may be observed that the first and second are now the common property of evolutionists, and are recognized everywhere as matter of fact. The names which I selected to express them have, however, only come into partial use. The author believes that, although the doctrine was vaguely shadowed out in the minds of students prior to the publication of this essay, it had not previously been clearly expressed, nor been reduced to a demonstration. Of the truth of the doctrine the author is more than ever convinced, and he believes that paleontological discovery has demonstrated it in many instances, and that other demonstrations will follow. The fourth proposition (that of homologous groups) is now held as a hypothesis explaining the phylogeny of various groups of animals. For the descent of one homologous group from another, the term *polyphyletic* has been coined. It remains to be seen whether the doctrine is of universal application or not. That homologous groups belong to different geological horizons, as stated under the fifth head, has been frequently demonstrated since the publication of the essay. That the sixth proposition is true in a certain number of cases is well known, and it follows that the seventh proposition is also true in those cases. The latter hypothesis, which was originally advanced by Professor Agassiz, is, however, only partially true, and the advance of paleontological study has not demonstrated that it has had a very wide application in geological time.

"A proposition which was made prominent in this essay was that the prevalence of non-adaptive characters in animals proves the inadequacy of hypotheses which ascribe the survival of types to their superior adaptation to their environment. Numerous facts of this kind undoubtedly indicate little or no activity of a selective agency in nature, and do point to the existence of an especial developmental force acting by a direct influence on growth. The action of this force is the acceleration and retardation appealed to in this paper. The force itself was not distinguished until the publication of the essay entitled 'The Method of Creation' [1871], where it was named growth-force, or bathmism. The energetic action of this force accounts for the origin of characters, whether adaptive or non-adaptive, the former differing from the latter in an intelligent direction, which adapts them to the environment. The numerous adaptive characters of animals had by that time engaged the attention of the author, and he found that they are even more numerous than the non-adaptive. Some of the latter were accounted for on the theory of the 'complementary location of growth-force.'"

We can only consider the 'law of acceleration and retardation.' Again it behooves us to seek his own definition:

"*a.* The succession of construction of parts of a complex was originally a succession of identical repetitions; and grade influence merely determined the number and location of such repetitions.

"*b. Acceleration* signifies addition to the number and location of such repetitions during the period preceding maturity, as compared with the preceding generation, and *retardation* signifies a reduction of the number of such repetitions during the same time.*

His meaning may best be inferred from his application to mankind. This was done in the following terms in 1872:†

"Let an application be made to the origin of the human species It is scarcely necessary to point out at the start the fact, universally admitted by anatomists, that man and monkeys belong to the same order of Mammalia, and differ in those minor characters, generally used to define a 'family' in zoology.

"Now, these differences are as follows: In man we have the large head with prominent forehead and short jaws; short canine teeth without interruption behind (above); short arms, and thumb of hand not opposable. In monkeys we have the reverse of all these characters. But what do we see in young monkeys? A head and brain as large relatively as in many men, with jaws not more prominent than in some races; the arms not longer than in the long-armed races of men, that is, a little beyond half way along the femur. * * * At this age of the individual the distinctive characters are therefore those of *homo*, with the exception of the opposable thumb of the hind foot, and the longer canine tooth. * * *

"Now in the light of various cases observed, where members of the same species or brood are found at adult age to differ in the number of immature characters they possess, we may conclude that man originated in the following way: that is, by a delay or retardation of growth of the body and fore limbs as compared with the head; retardation of the jaws as compared with the brain case, and retardation in the protrusion of the canine teeth."

There is good reason for thinking that fallacy is involved in this argument and that quite a different interpretation should be put on the evolution of the characters in

*Proc. Am. Phil. Soc., 1871; Origin of Fittest, p. 182.

†Penn. Monthly Mag., 1872; Origin of the Fittest, p. 11, 1887.

question. It is not the fore limbs that are retarded in man, but the hind limbs have become enlarged (compare the adult and the infant). There is not retardation of the jaws, but a special teleological adaptation. Man has for the most part at least discontinued the use of his teeth for warfare, and as a result of diminished use the canines have become reduced and the diastemata of the dental series been obliterated. The brain has grown after birth and become enlarged, and as a consequence the brain case has extended forward—the reverse of what occurs in the apes. Concomitantly with the diminished use of the teeth and jaws, the masseter and temporal muscles have become reduced, and the sagittal and lambdoidal ridges have consequently became atrophied. The ecarinate rounded voluminous calvarium is the result.

It has been claimed that the young of higher species 'are constantly accelerating their development.' In many, however, development is retarded, inasmuch as infancy and juvenility are prolonged far beyond the periods observed in our simian relatives.

Such examples as this give cause to believe that the 'law of acceleration and retardation' has been at least unduly extended. Acceleration and retardation are, however, to a large extent, terms which express facts of evolution; whether the word law is applicable may depend on the meaning one gives the word.

The transmission of acquired characters was one of the accepted and most cherished dogmas of Cope, and the belief in transmissibility of such characters is an essential of the creed of so many who have become his followers in America that a special school came into existence known as the Neo-Lamarckian and also as the American School. My own prejudices have inclined me to that school. Nevertheless, when I have divested myself of such prejudices as well as I could, I have been compelled to admit that the evidence of the heredity of acquired characters was rather weak. There was, indeed, evidence for, a well as against, but that against the doctrine of the transmissibility of acquired characters seems to be the most weighty.

It is to be understood that the acquired characters considered in this connection are such as have been developed during postnatal life as a result of endeavors of the animal or of the influence of external agencies. The evidence presented has been mostly in support of the contention that the characters acquired have been directly inherited by offspring, and consequently the transition from the form not possessing the character to one having it is rapid. The evidence adduced has not been conclusive, to say the least. There is, apparently, a germ of truth in the proposition that acquired characters are transmitted, but in a modified sense, and the case has been weakened rather than strengthened by the evidence offered.

The evidence for inheritance of acquired characters was frequently given by Cope and in his last published work—'The Primary Factors of Organic Evolution,'—he marshalled the testimonies of many witnesses with his accustomed skill. He evoked 'evidence from embryology,' 'evidence from paleontology,' 'evidence from breeding;' he considered the 'characters due to nutrition,' 'characters due to exercise of function,' 'characters due to disease,' 'characters due to mutilation and injuries,' and 'characters due to regional influence'; he inquired into 'the conditions of inheritance,' and he fought against the 'objections to the doctrine of inheritance of acquired characters.' I have gone over all this evidence and yet I have not been convinced that the contention has been sustained that character acquired during the external life of an animal are transmitted. Many cases are alleged to sustain the 'inheritance of charac-

ters due to mutilation and injuries.' Some of these may be considered as mere coincidences; others provoke skepticism for one reason or other. To discuss them would be out of place here. But at least we may meet evidence with counter-evidence.

On the one hand, all the data and experiments recapitulated in the cases enumerated concern only two, or at most very few, generations of the animals in question, and were within the compass of a single man's life-time.

On the other hand, we have data and observations of the most reliable nature, and of an extraordinary compass. These have resulted not from experiments for the determination of a specific question, but from observances of a religious character. They were really in the nature of surgical operations, but for our purpose may be looked upon as experiments and have the value of contrived experiments. In no other field has such a series of disinterested experiments been available. They were conducted on countless millions of mankind and for thousands of years. The subjects experimented upon were kept isolated from others alike by their own prejudices and the prejudices of their neighbors. Circumcision is the term applied to the experiments in question.

For about 4,000 years circumcision has been practiced on a gigantic scale. Every male child among the Jews was operated upon, not only in Palestine, but wherever representatives of the race had wandered and adhered to their religion; religion itself was involved in the operation and it was regarded as a holy rite; the most scrupulous attention was paid to details. The operation was performed eight days after birth, and consequently there could be no functional activity of the tissues concerned. But after 4,000 years the newborn boys of the race come into the world with the special integument developed as much as in those of other races. Even the principle of atrophy through disuse has not become manifest in the case.

Other evidence, it seems to me, is the result of confounding the potentiality of a function with its manifestation. I allude to one set of examples on account of the interest of the cases, and I do so with the deference due to the eminence and ability of the gentleman who has furnished the evidence. That evidence has been collected under the head of 'inheritance of characters due to the exercise of function.' The evolution of the American trotting horse was considered. It was recorded that "by 1810 the taste for trotting as a sport had * * * increased here, and in 1818 it became a recognized sport under specific rules." * * * "At the end of 1824, six years after the first accepted three-minute record, the record had fallen to 2:34." * * * "By 1848 the record was lowered to 2:29½; the next decade lowered the record five seconds." Finally, at the close of 1895, the record had been furthered lowered to 2:08¼. * * * It is deduced from these premises that "there is nothing whatever in the actual phenomena observed anywhere along the line of this development of speed that would lead us to even suspect that the changes due to exercise of function had *not* been a factor in the evolution." But to me it seems that there is no evidence to show that the speed attained was other than would have resulted from taking the same animals untrained and then speeding the last. The speed is, of course, simply the expression of functional adaptation, and the horses were selected merely because, by their manifestation, they showed that they had the coordination of structural and psychological characters needed for the manifestation of the function. The manifestation guided the breeder to the selection of the animals. The successful animals were the pick of thousands unknown to fame.

But there is much in the history of the development of animals that seems to lead to the belief that eventually modifications may be due in part to acts of representatives of the phylum to which they belong. It is difficult to believe that some structural features are simply the result of natural selection operating on chance variations. An application of the doctrine of chances to some such cases appears to be adverse to the conception that they represent the influence of natural selection unaided.

A feature characteristic of most cave animals of widely diverse groups and classes is the atrophy of the eyes, and it seems to be most logical to attribute this to disuse of those organs in remote progenitors, and to assume that the atrophy may have resulted from a failure of nourishment by the nutrient fluid of the organs on account of the loss of functional activity rather than to selection by nature of forms with successively diminishing eyes. The presence of eyes in most cases certainly would scarcely be an element of disadvantage to animals, and it may be allowable to invoke some other agency than chance selection. We may be justified in postulating that the continuous disuse of the organs would in time react on the nutrition of the parts affected, and finally atrophy or disappearance would result. Like explanation would be applicable to the innumerable cases of atrophy of parts known to the naturalist.

But if cessation of nutrition culminates in final atrophy, increased nutrition of parts may result in hypertrophy and increased nutrition may be the concomitant of increased activity of parts. The exercise of such parts continued for many generations may react on the organization and the progeny at length be affected thereby. Of such cases Cope adduced many examples. The feet of the horse line furnish illustrations. The existing horse has the median toes and hoofs greatly hypertrophied and the lateral ones atrophied, but the remote ancestors had feet of nearly the same general pattern as the rhinoceroses and tapirs. Atrophy of the lateral digits has progressed inversely to hypertrophy of the middle ones. An analogous line of development culminating in feet superficially much like those of the horse was followed by another quite remote family of hoofed mammals, the Prototheriids of South America.

The idea of acceleration and retardation were associated by Cope with the idea that the course of evolution was determined from the beginning of things, and that life, to use his own words, is '*energy directed by sensibility or by a mechanism which has originated under the direction of sensibility.*' He maintained that 'consciousness as well as life preceded organism,' and he called this conception 'the hypothesis of archæsthetism.' This idea I refer to especially because it was broached in his vice-presidential address, delivered at the meeting of the American Association for the Advancement of Science in Philadelphia in 1884.*

I am myself unable to comprehend consciousness except as a product or result of organization, and those who wish to learn more about Cope's views respecting the question must refer to one of his many papers.

Whatever may be thought of Cope's philosophical views, his presentation of them is always interesting and some of them are illustrated with a wealth of facts that renders his communications valuable as repertories of well digested information. His first special paper, on 'The Origin of Genera,' published as early as 1868, is especially noteworthy for the mass of morphological data contained in it and for the apt manner in which they are tabulated.

VIII.

I venture to conclude with some reflec-

* Origin of Fittest, p. 425.

tions on the rank that may be assigned to Cope in the world of science.

Among those that have cultivated the same branches of science that he did—the study of the recent as well as the extinct Vertebrates—three naturalists have acquired unusual celebrity. Those are Cuvier, Owen and Huxley.

Cuvier excelled all of his time in the extent of his knowledge of the anatomical structure of animals and appreciation of morphological details, and first systematically applied them to and combined them with the remains of extinct Vertebrates, especially the mammals and reptiles. He was the real founder of Vertebrate paleontology.

Owen, a disciple of Cuvier, followed in his footsteps, and, with not unequal skill in reconstruction and with command of ampler materials, built largely on the structure that Cuvier had begun.

Huxley covered as wide a field as Cuvier and Owen, and likewise combined knowledge of the details of structure of the recent forms with acquaintance with the ancient ones. His actual investigations were, however, less in amount than those of either of his predecessors. He excelled in logical and forcible presentation of facts.

Cope covered a field as extensive as any of the three. His knowledge of structural details of all the classes of Vertebrates was probably more symmetrical than that of any of those with whom he is compared; his command of material was greater than that of any of the others; his industry was equal to Owen's; in the clearness of his conceptions he was equalled by Huxley alone; in the skill with which he weighed discovered facts, in the aptness of his presentation of those facts, and in the lucid methods by which the labor of the student was saved and the conception of the numerous propositions facilitated he was unequalled. His logical ability may have been less than that of Huxley and possibly of Cuvier. He has been much blamed on account of the constant changes of his views and because he was inconsistent. Unquestionably he did change his views very often. Doubtless some of those changes were necessitated by too great haste in formulation and too great rashness in publication. The freedom to change which he exercised, and which was exercised too little by at least one of his predecessors, was an offset to his rashness. He exercised a proper scientific spirit in refusing to be always consistent at the expense of truth.

His reputation at present is much inferior, at least among the people at large, to those of the men with whom he has been compared. Immediate reputation depends on various circumstances, some of which are quite adventitious, and it is often long before men find their true levels. It is scarcely premature to prophesy that Cope's reputation will grow and that in the future history of science his place will be at least as large as that of any of his predecessors.

THEO. GILL.

WASHINGTON.

EXPERT TESTIMONY.*

IT will be remembered that a would-be facetious barrister once remarked that prevaricators might be properly arranged in an ascending series, to wit: ordinary fibbers, liars and experts; an arrangement which I fear meets with the approval of many members of the bench and bar today. The cause for such harsh classification is not so very far to seek. It is based upon ignorance on the part of the bar, and at times upon what is worse than ignorance on the side of the 'expert.' With the culpable acts of the pseudo scientist we cannot waste our time. That he merits

* Address of the Vice-President and Chairman of Section C (Chemistry) at the Detroit meeting of the American Association for the Advancement of Science.

prompt condemnation is axiomatic, but a word is wanted touching upon what may be termed the ignorance of the Court.

"When I take my place upon the witness stand," said a prominent toxicologist once to me, "I can never predict in what shape I shall be upon leaving it;" a feeling with which most of us can, I fancy, sympathize pretty keenly.

Is it that we fear exposure of the weak points in our professional armor? Do we dread to say in public, "I do not know?" Hardly that, I take it. We are now possessed of so very little of that which one day may be known that no true scientist hesitates for an instant to plead legitimate ignorance. What really troubles us upon cross-examination is that the Court does not speak our language, a language often quite difficult of direct translation; that it is but rarely schooled in the principles of our science; and that, in consequence, it frequently insists upon categorical answers to the most impossible kind of questions.

The hypothetical questions showered upon the expert witness are sometimes veritable curiosities, so peculiar are they in their monstrosity. Who among us but has felt that the layman, who has simply to testify to observed facts, has an easy time of it, indeed, when compared with him from whom there is expected an opinion under oath?

All scientific men are willing and anxious to have their work scrutinized carefully by their peers; but to be exposed to the one-sided criticism frequently encountered at the bar is quite another matter; for it must be remembered that, after the adverse counsel has opened up what appears to be a glaring inconsistency in the testimony, the re-direct examination may utterly fail to repair the breach, because of a lack of familiarity with a technical subject on the part of the friendly attorney.

This leaves the witness in the uneviable position of disagreeing with the general drift of his own testimony, while it deprives him of suitable means of insisting upon its revision and correction.

According to the writer's view, there is but one way to escape such dilemma, and that is by direct and immediate appeal to the Judge, urging that the oath taken called for a statement of the whole truth, and not the misleading portion already elicited.

To illustrate how serious a matter the partial testimony of an expert witness may be, and to show also to what extent lawyers may go who look only to the winning of their causes, permit me to refer to an already reported poison case in which I was employed by the people. It may be roughly outlined as follows:

Much arsenic and a very little zinc were found in the stomach.

The body had not been embalmed, but cloths wrung out in an embalming fluid containing zinc and arsenic had been spread upon the face and chest.

Medical testimony showed that no fluid could have run down the throat. Knowing the relative proportions of zinc and arsenic in the embalming fluid, the quantity of arsenic found in the stomach was twelve times larger than it should have been to have balanced the zinc also there present, assuming them to have both come from the introduction of the said embalming fluid by cadaveric imbibition. Other circumstantial evidence was greatly against the prisoner.

At the time of my appearing for the people, on the occasion of the first trial of the case, my direct testimony brought out very strongly the fact that a fatal quantity of arsenic had been found in the stomach, but no opportunity was given me to testify to the presence of the zinc found there as well, although the fact of its existence in the body was known to the prose-

cution through my preliminary report. Through ignorance of the nature of such report on the part of the defence, no change was made in the character of the testimony during the cross-examination, and I was permitted to leave the witness stand with a portion of my story untold. No witnesses were called for the defence, and the case was given to the jury with the darkest of prospects for the prisoner.

For many reasons, unnecessary to recount here, I was distinctly of the opinion that murder had been committed, but I felt nevertheless that common justice demanded that the prisoner should have been entitled to whatever doubt could have been thrown upon the minds of the jury, no matter how far-fetched the foundations for such doubt might have been.

The first trial having resulted in a disagreement of the jury, I was pleased to learn, before the second hearing of the case began, that the defence was prepared to go into the question of the embalming fluid; for the responsibility of permitting only a part of what I knew to be drawn from me, to the entire exclusion of the remaining portion, was greater than I wished to assume. The nature of my report to the Coroner having been established, and certain opinions relating thereto having been fully ventilated, the jury were possessed of 'reasonable doubt' and acquitted the prisoner. What now were the duties of the expert upon the occasion of the first trial of this case and how should he have construed the meaning of his oath?

One eminent legal light, to whom the question was referred, held that the expert was distinctly the property of the side employing him, and that his duty was simply to answer truthfully the questions put to him, without attempting to enlighten the Court on facts known to him, but not brought out by the examination, no matter how vital such facts might be.

Another held that although the above course would be proper in a civil case, yet, in a matter involving life and death, the witness should insist upon the Court becoming acquainted with his whole story. Do not such differences in legal opinion make it very desirable that the expert, at least in capital cases, should be an employee of the bench rather than of the bar, in order that whatever scientific investigations are made may be entirely open to public knowledge and criticism?

Although the expert should earnestly strive to have what he has to say presented in the best form, he must remember that to secure clearness, particularly before a jury, technicalities should be reduced to a minimum. To a degree they are unavoidable, but let them be as few as possible. Illustrations should be homely and apt; capable of easy grasp by the jury's minds, and, if possible, taken from scenes familiar to the jury in their daily lives.

It is an unfortunate fact that the expert must be prepared to encounter in the court room not only unfamiliarity with his specialty, but also deep-rooted prejudices and popular notions hoary with age and not to be lightly removed from the mind by the words of a single witness. As President Jordan has well said, "There is no nonsense so unscientific that men called educated will not accept it as a science;" and, let me add, they will calmly attempt to shove the burden of proof upon the scientific man who is opposed to their views. Sanitary experts, in particular, run up against all sorts of popular superstitions and are inveighed against as 'professors' by those who consider themselves the 'practical' workers of the time; and, let it be noted, the burden of proof is uniformly laid upon these 'professors'' shoulders, while the most astounding and occult statements made by the 'practical' men may be received without verification.

One source of trouble, which perhaps is

peculiar to the water expert, lies in the impossibility of utilizing analytical results such as were made many years ago.

Those who are not chemists fail to grasp the fact that the examinaton of water may not be looked upon from the same point of view as the analysis of an iron ore. The statement that water analysis is of recent birth, and that it is yet in its infancy, is hard for them to appreciate, holding, as they naturally do, that what was true twenty years ago must be true to-day, if science does not lie.

A pit into which many an expert witness falls is prepared for him by insidious questions leading him to venture an opinion on matters outside of his specialty. It is a fatal error to attempt to know too much. Terse, clear answers, well within the narrow path leading to the point in question, are the only safe ones; and when the line of inquiry crosses into regions where the witness feels himself not truly an expert, his proper course is to refuse to testify outside of the boundaries of his legitimate province.

Unfortunately, the expert is as often invited to take these collateral flights by the side employing him as by the opposition. Affidavits in submitted cases are commonly written by the lawyers and not by the expert, although they are, of course, based upon his reports. In the strength of his desire to win the case, the lawyer often prepares a much stronger affidavit than his witness is willing to swear to.

The writer has had no little difficulty just at this point, and has had plenty of occasion to observe the irritation displayed by counsel upon a refusal to endorse statements which have been 'too much expanded.'

Every expert witness, especially in his early cases, is sure to have adverse authorities quoted against him; therefore it behooves him to be so familiar with the literature of his subject as to be capable of pointing out that such and such a writer is not up to date, or that such and such a passage, if quoted in full, would not bear the adverse construction that its partial presentation carries. When the expert reaches a position of such prominence that he can state a thing to be so because he says it, irrespective of whatever may be written on the subject to the contrary, his course then is greatly simplified; but long before he attains that altitude he will have put himself upon record in many cases, and happy for him if the record so made be such as cannot be quoted to his disadvantage.

"If I had only not written my first book," is the reflection of many a distinguished author; while one of the great masters of music, referring to an opera, said: "It is one of my early crimes."

Above all things, the expert should "provide things honest in the sight of all men."

It is well for him to be deeply interested in his case, to feel in a measure as if it were his own, but it is unwise in him to become so partisan as to let his feelings affect his good judgment, and it would be indeed criminal should he permit his interest in any way to contort the facts.

Before the case is brought to a final hearing, it may be apparent that experiments before the Court are possible and they may be demanded by the counsel in charge of the case. If such experiments be striking, easy of execution, and not too long, by all means make them.

Practical illustrations, particularly such as involve some fundamental principle, have great weight with the Court; but these illustrations must not be such as would turn the court room into a temporary laboratory and involve the loss of much time in vexatious waitings.

Such experiments as are determined upon should be thoroughly rehearsed beforehand, no matter how simple they may be; for, of

all failures, the court-room experiment which declines to 'go off' is perhaps the most dismal.

This brings to mind a kindred topic upon which there should be a word of caution; laboratory experiments which work to perfection may utterly fail when expanded to commercial proportions, so that it is wise to bear in mind the danger of swearing too positively as to what will happen in large plants, when the opinion is based only upon what is observed to occur upon the smaller scale. Like conditions will, of course, produce like results, but it is marvellous how insidiously unlooked-for conditions will at times creep into one's calculations, and how hard it is even to recognize their presence.

When preparing his case for presentation, the expert often errs in not dwelling more largely upon certain points because he thinks them already old and well known. To him they may be old, but to the public they may be of the newest. Not only is the public unequally posted with the specialist, but what it once knew upon the subject may have been forgotten. Is is well, therefore, to insert, in a special report, matters that would be properly omitted from a paper prepared for a professional audience.

Sanitary problems are of especial interest to the public, but the amount of ignorance, or rather false knowledge, displayed concerning them is surprising and often difficult to combat. The sanitarian is not unfrequently called upon suddenly to defend a position involving complex statistics; and, because the data cannot be forthwith produced, the inference is drawn that his points are really without facts to support them and that they are consequently not well taken.

Long before he gets into Court, particularly if the time for preparation of the case be short, the expert may well 'pray to be delivered from his friends.' He may receive a peremptory order by telegraph to 'determine the mineral qualities of this rock,' when the telegram should have read 'Assay this ore for silver;' and later it may be a matter of surprise that a quantitative knowledge of the copper present was not obtained while passing along the line for the determination of the silver; for it is generally not known that the complete analysis of anything is quite rare and correspondingly tedious and expensive.

Toxicologists who hear me may call to mind some case involving a search for the presence of an alkaloid, strychnia for example, during which search the District Attorney, in his eagerness for information may have asked to know what the indications were as to the presence of the poison, at a time when the extraneous organic matter was not nearly removed. He may have wished no final report, but only the simple probabilities, whereon to base a possible arrest. Such requests are very common, and are akin to a demand for a proof of the pudding during the early baking, when we all know that such proof comes at a much later stage of the proceedings.

Finally, "When doctors disagree who shall decide?"

This question is often very vigorously settled by the jury, as was instanced in a recent celebrated murder trial in New York City. In that case what the experts had to say on either side was simply thrown overboard as a whole, and the finding was based upon the testimony of the remaining witnesses.

What can be said upon this question of the disagreement of expert witnesses? First, it must be noted, they are far from being the only class of people who fail to agree, and that too on very important subjects. Do my hearers think it would be a very difficult task to find a small army of men who would testify very variously and very posi-

tively upon questions of politics or religion? Would it be hard to find 'good men and true' who would give under oath greatly differing opinions concerning the propriety of instituting free trade or establishing an inheritance tax? Experts are subject to the same errors of judgment as befall the rest of professional humanity, and when their opinions clash they are entitled to the same respect that we grant to the members of the bench when they hand down the decision of a divided Court.

One fruitful opportunity for disagreement always arises when questions are brought into Court touching upon matters newly discovered and apart from the well beaten path of common professional knowledge. Doubt is often left upon the minds of those seeking the light, even when the testimony is given by the specialist who originally developed the new point in question, for one cannot be expected to be thoroughly educated in that which he has himself but recently discovered.

Many of us have dreaded to see the 'ptomaines,' or putrefactive alkaloids, make their way into Court with their mystifying influences upon Judge and jury and their tendency to protect crime. Now they are in, what is to be the end? Even with no 'Ptomaine theory' possible, the ptomaine form of argument is not unknown. The writer was once asked in an arsenic case whether he was willing to swear that at some future time an element would not be discovered giving the stated reactions now called arsenical. Such nonsense is, of course, instituted to impress the jury, and is suggested by similar questioning in the alkaloid cases.

A recent and somewhat amusing instance arose from an attempt to introduce the rather new conception of 'degeneracy' into a murder trial. The defence sought to show that the prisoner was a 'degenerate' and offered expert testimony as to the meaning of the term and as to the signs whereby such a condition was to be recognized, whereupon the prosecution called attention to the fact that the defendant's experts themselves exhibited every one of the signs in question.

Having said all that he was to say, and having stated it to the best advantage, should the expert depend upon the stenographer so recording it as to allow of its being used in future without correction? Decidedly not.

The average stenographer is unfamiliar with technical terms, especially such as are chemical, and the witness who fails to supervise the minutes may find out later that he has sworn to a most remarkable array of 'facts.' The writer once discovered that he had recommended, as a very efficient method of purifying a city water, the filtering of the entire supply 'through a layer of black mud.' Not to take your time further, let us summarize what has thus been briefly said:

The expert witness should be absolutely truthful, of course; that is assumed, but beyond that he should be clear and terse in his statements, homely and apt in his illustrations, incapable of being led beyond the field in which he is truly an expert, and as fearless of legitimate ignorance as he is fearful of illegitimate knowledge.

Mounting the witness-stand with these principles as his guide, he may be assured of stepping down again at the close of his testimony with credit to himself and to the profession he has chosen.

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CURRENT NOTES ON ANTHROPOLOGY.

ARAUCANIAN STUDIES.

DR. RODOLFO LENZ continues his excellent studies on the Araucanian dialects and folk-lore, in the 'Anales de la Universidad

de Chile.' His last contribution embraces seven semi-mythical tales in the Pehuenche dialect, the original text and a Spanish translation. They offer much curious material, and often leave it doubtful whether the story is of native origin or borrowed from European sources. The first, for example, tells of a dead lover who came from his grave to claim his bride and carried her to his tomb. In spite of the striking similarity of this to the legend embodied in Bürger's ballad 'Lenore,' the editor believes it to have been from native sources.

Unfortunately, like so many other tribes, the Araucanians were little studied by the early settlers, and the knowledge we have of their mythology is vague and slight. Dr. Lenz very properly observes that it is all the more important to collect what still survives in their songs and stories; and, it may be added, the scholarly manner in which he presents his researches to the reader renders them models of work of this kind.

THE 14TH REPORT OF THE BUREAU OF ETHNOLOGY.

THIS report (for 1892–93) has just been distributed. It is in two parts or volumes counting up to over twelve hundred pages! The contributions are three in number, the first an exceedingly interesting paper by Mr. James Mooney on the ghost dances of our Western tribes; the second a study of the Menomini Indians, by Dr. Walter J. Hofman, containing a mass of accurate observations; and the third an erudite treatise on the expedition of Coronado to New Mexico in 1540, by Mr. George Parker Winship.

It is needless to dwell on the value of these contributions to the history and ethnography of our country. Every future student of these subjects will owe a debt to this and previous reports of the Bureau. No series of publications by our government has been edited with more conscientious care, and none can show a list of articles of a higher class, or of more permanent importance, than the Bureau of Ethnology. It should be a matter of patriotic pride, based on the recognition of solid merit, for the government to render liberal aid to this scientific department and increase the means of its usefulness.

D. G. BRINTON.
UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

A LECTURE by Professor William Crookes on 'Diamonds' was delivered June 11, 1897, at the Royal Institution. It has been reprinted in the *Chemical News* and is perhaps the best brief treatise on the diamond ever written. The latter part of the lecture was devoted to the origin of the diamond as illustrated by the diamond 'pipes' of the Kimberley field. According to Professor Crookes the diamonds crystallized out of molten iron containing carbon in solution and at sufficient depth below the surface to give great pressure. Water finding its way down to this iron, the gas generated bored out the 'pipes' which were, "at the subsidence of the great rush, filled with a water-borne magma in which rocks, minerals, iron oxid, shale, petroleum and diamonds are churned together in a veritable witch's cauldron," a mud volcano. "It may be that each volcanic pipe"—of the South African fields—"is the vent for its own special laboratory—a laboratory buried at vastly greater depths than we have reached or are likely to reach—where the temperature is comparable with that of the electric furnace; where the pressure is fiercer than in our puny laboratories and the melting point higher; where no oxygen is present, and where masses of carbon-saturated iron have taken centuries, perhaps thousands of years, to cool to the solidifying point. Such

being the conditions, the wonder is, not that diamonds are found as big as one's fist, but that they are not found as big as one's head. The chemist arduously manufactures infinitesimal diamonds, valueless as ornamental gems; but Nature, with unlimited temperature, inconceivable pressure and gigantic material, to say nothing of measureless time, produces without stint the dazzling, radiant, beautiful crystals I am enabled to show you to-night."

PROFESSOR MOURELO, of Madrid, has investigated the preparation of a strongly phosphorescent strontium sulfid. The pure compound shows no phosphorescence, but the presence of a small quantity of alkali seems necessary, and a trace of subnitrate of bismuth is of advantage. When the mass which has been strongly heated is very slowly cooled, it shows after the action of even very little light, a strong phosphorescence. This property is lost on pulverization, but may be restored by long heating with starch.

IN the *Zeitschrift für Angewandte Chemie* Th. Bokorny gives the results of a study of the antiseptic action of various substances. A culture medium of half per cent. egg albumen or peptone, with one-tenth per cent. potassium phosphate, two-tenths per cent. magnesium sulfate and a trace of calcium chlorid was infected with the bacteria of decay, and after addition of the substance to be tested, placed for several days in an incubator. Among inorganic compounds silver nitrate and mercuric chlorid have about the same value, 0.002 %, killing all organisms in two days. The antiseptic limit with silver nitrate is 0.0002 %; with mercuric chlorid 0.001 to 0.0002 %. Copper sulfate is nearly as active, 0.005 % killing all organisms in twenty-four hours, and 0.001 % preventing decomposition. Zinc sulfate 0.01 % kills infusoria in eighteen hours, but 0.1 % is not completely antiseptic, while cadmium sulfate toward algæ and infusoria is weaker than the zinc salt, but toward bateria stronger, 0.02 % being antiseptic. Lead acetate and nitrate in 0.1 % solution only delay decay, while it is prevented by the same strength of iron sulfate solution. The fluorids are not strong antiseptics, the limits being for hydrofluoric acid 0.02 %, barium fluorid 0.3 %, aluminum fluorid 0.1 %, calcium fluorid 0.03 %, ferric fluorid 0.06 %, magnesium fluorid 0.05 %. Ammonium fluorid 0.1 % is without action, but sodium fluorid 0.1 % is antiseptic; potassium fluorid is rather more active. J. L. H.

NOTES ON ENGINEERING.

A COMMITTEE of the British Institution of Civil Engineers, appointed a year ago or more, have reported the following recommendations on steam-engine efficiency, and they have been adopted by the Council:

(1) That the statement of the economy of a steam-engine in terms of pounds of feed-water per I.HP. per hour is undesirable.

(2) That for all purposes except those of a scientific nature it is desirable to state the economy of a steam-engine in terms of the thermal units required per I.HP. per hour (or per minute), and that if possible the thermal units required per brake HP. should also be given.

(3) That for scientific purposes the thermal units that would be required by a perfect steam-engine working under the same conditions as the actual engine should also be stated.

The proposed method of statement is applicable to engines using superheated steam as well as to those using saturated steam, and the objection to the use of pounds of feed-water, which contain more or less thermal units according to conditions, is obviated, while there is no more practical difficulty in obtaining the thermal units per I.HP. per hour than there is in arriving at the pounds of feed-water.

For scientific purposes the difference in the thermal units per I.HP. required by the perfect steam-engine and by the actual engine shows the loss due to imperfections in the actual engine.

A further great advantage of the proposal is that the ambiguous term 'efficiency' is not required.

IN the contest which has now been so long

waged over the disputed originality of invention of the high explosive 'cordite,' Mr. Hiram Maxim, one of the contestants, and one in whom his fellow-countrymen in the United States feel much interest, is, for the time at least, defeated. Referring to this important case, one of the English technical journals, *Industries and Iron*, makes the following remarks: "The appeal of the Maxim-Nordenfelt Guns and Ammunition Company against the judgment delivered by Mr. Justice Wright in the Cordite case has been, as was generally anticipated would prove to be the case, against the appellants. The judgment of the Court was couched in somewhat uncompromising language, and it is doubtful whether the Maxim-Nordenfelt Company will consider it advantageous to carry the matter any further. Although the Court is no doubt perfectly right in its definition of the nature of the invention comprised in Mr. Maxim's patent, as against that of Sir Frederick Abel and Professor Dewar, none can deny the fact that Mr. Maxim was the undoubted pioneer in smokeless powders as we now know them, and it will be conceded by most that the recent decision involves a certain degree of hardship. Mr. Maxim's invention of a smokeless powder was not an accidental discovery; he was forced into the course of the investigation he took up by the necessity of procuring a powder which would be suitable for the rapid-firing gun which he had invented. He found that the use of the ordinary powder practically destroyed the utility of his gun, by surrounding it with such clouds of smoke that it was impossible to take aim. Mr. Maxim then deliberately set himself to the purpose of producing a powder which should be almost, if not altogether, smokeless. In this he was absolutely successful, and he has only shared the fate of many other inventors in seeing the fruits of his invention taken away from him through legal technicalities."

A FOREIGN exchange makes the following very unequivocal statement relative to our later systems of procedure in the Patent Office. A recent change in the law prevents any such delay, whether intended or otherwise on the part either of the holders of the patent or of the officer of the Patent Office: "The amazing circumstances which characterized the issue of the Berliner patent, to which is due the controlling interest in the United States of the Bell Telephone Company, have been paralleled by the well-known Bradley patents, which are now creating a good deal of stir among the manufacturers of aluminium and carbide of calcium. In the former case, the patent lay in the Patent Office for a period of no less than thirteen years before it was formally issued to the public. The Bradley patents were similarly interred for nine years before they were resurrected for the purpose of being used against the Pittsburg Reduction Company. It must be a gratifying reflection to those interested in patents and inventions in the United States that the singular course of procedure suggested by the foregoing instances will not be allowed to characterize the American Patent Office much longer. On January next the new regulations come into force, by which it is enacted that the issue of a patent shall be compulsory within a certain definite period from the date of application; and, under these circumstances, it seems likely that the familiar legend 'Patent applied for' on American manufactures will shortly become effete."

R. H. T.

SCIENTIFIC NOTES AND NEWS.

IN view of the International Congresses of Geology and Medicine, meeting in Moscow during the present month, the tenth meeting of Russian men of science and physicians, which was to have been held at Kief during the same month, has been postponed until 1898.

THE President of the local executive commit-

tee of the British Association for the Advancement of Science announces that McMaster University, a college residence, has been selected as the headquarters of the American Physiological Society during the Toronto meeting of the British Association. Rooms and board may be obtained there at $1.50 to $2.00 per day.

THE French Association for the Advancement of Science will meet next year at Nantes. At the meeting being held this week at St. Étienne the public lecture was to have been given by M. Gariel, on the Röntgen rays. Subjects proposed for special discussion were: Section of Physics, 'Atmospheric Electricity;' Section of Meteorology, 'The Study of Clouds;' Section of Geology, 'The Formation of the Fossiliferous Basins of the Central Plateau;' Section of Hygiene, 'The Part played by Leaves of Absence from School in the Spread of Contagious Diseases.'

A MEETING of the Council of the Australasian Association for the Advancement of Science was held at the Royal Society's House, Sydney, on June 17th, with fifteen members in attendance. Letters were read from the Royal Society of Tasmania, the Melbourne Branch of the Royal Geographical Society and the Medical Society of Queensland, suggesting a memorial to the late Baron von Müller. A preliminary committee was appointed to make arrangements for the meeting to be held at Sydney in January next. A large number of papers have been promised for the several sections; Section G., Economic Science and Agriculture, leading with twenty-eight papers, followed by Section F., Ethnology and Anthropology, and Section J., Mental Science and Education, each with eighteen papers.

JAMES HAMMOND TRUMBULL, LL.D., the well-known philologist, died in Hartford, Conn., August 5th, aged seventy-six years. For many years he paid especial attention to the subject of the Indian languages of North America. He was a member of the National Academy of Sciences and of many other learned societies.

WE regret also to record the death of Captain Bertram Lutley Sclater, son of the eminent zoologist, who died at Zanzibar on July 24th, at the age of thirty-one years, of fever contracted while making surveys and explorations in British Central Africa; of Dr. Golowkinskie, formerly professor of mineralogy and geology in the Universities of Kasan and Odessa, at Kastel, on June 9th, and of M. Étienne Vacherot, formerly professor of philosophy and assistant to Cousin, and the author of numerous contributions to philosophy, political economy and science, at the age of eighty-six years. M. Vacherot took a prominent part in French politics, having been one of the Mayors of Paris during the siege.

DR. WILHELM THIERRY PREYER, whose death we recently noticed, was a man of unusual versatility and originality. He was born in Manchester, England, in 1841, and received his education in that country until he was sixteen years old. After studying at various German universities and at Paris, he qualified as docent in the University of Bonn, first in zoology and afterwards in physiology. His first work was in zoology, and he published several books treating of problems in which zoology and physiology are both concerned, such as 'The Struggle for Existence' (1869), 'Hypotheses regarding the Origin of Life' (1875), and 'Spontaneous Generation and the Conception of Life' (1879). In 1869 Preyer was made professor of physiology at Jena, but removed to Berlin in 1880 and qualified as docent in the University. He was not promoted to a professorship at Berlin and removed to Wiesbaden in 1893. In addition to the works mentioned above, Preyer wrote numerous articles and at least two volumes concerning the general problems of science, partly of a popular character. He published an 'Elements of General Physiology' in 1883 and had earlier published a book on the 'Five Senses of Man,' translated into English in the International Scientific Series. He also made many contributions to the physiology of the senses and to experimental psychology, and was one of the Board of Editors of the *Zeitschrift für Psychologie.* His volume on 'The Child's Mind' (1879) has been the starting point of numerous similar observations, though it is interesting to note that the first scientific biography of a child was written by Darwin. Preyer's versatility is

further illustrated by the fact that his last volume was on graphology.

THE statue of Darwin at the entrance to the public library and museum of Shrewsbury, to the erection of which, by the Shropshire Horticultural Society, we have already called attention, was to have been unveiled on August 10th. The statue, in bronze, is by Mr. Horace Montford.

ON the eleventh of July a monument was unveiled at Bresches to Velpeau, the eminent French surgeon.

A MEDALLION portrait of Pasteur, by M. Patey, after the medal by M. Roty, has now been placed on the wall of the École Normale Supérieure, the site of the former laboratory of Pasteur. The inscription previously inscribed on the tablet reads:

ICI FUT LE LABORATOIRE DE PASTEUR.
1857.—Fermentations.
1860.—Générations spontanées.
1865.—Maladies des vins et des bières.
1868.—Maladies des vers à soie.
1881.—Virus et vaccins.
1885.—Prophylaxie de la rage.

THE position of Assistant Chief of Division of Soils, Department of Agriculture, salary $1,800 per annum, is to be filled by the Civil Service Commission. Applicants must submit, not later than September 1st, original essays, either printed or in manuscript form, consisting of not less than 5,000 words, and containing a thorough treatment of the subject, 'Environment as affecting the yield, quality and time of ripening of crops.'

DR. JOHANNES MARTIN has been appointed Director of the Natural History Museum of Oldenburg, and Dr. Philippi, assistant in the Nattural History Museum in Berlin.

THE Prince of Wales has been elected a fellow of the Royal College of Physicians, London, or, as the English papers put it, he has complimented the profession by accepting the fellowship. As a non-medical fellow, the Prince has only three predecessors, the Marquis of Dorchester in 1658, the Duke of Manchester in 1717, and the Duke of Richmond in 1729.

THE Legislature of Uruguay has conferred honorary citizenship and the sum of $10,000 on Dr. Sanarelli as a recognition of his discovery of the yellow fever microbe.

THE Faculty of Philosophy of the University of Strasburg has conferred the honorary degree of Doctor of Philosophy upon Professor Flinders Petrie, the celebrated Egyptologist.

AT the annual general meeting of the British Medical Association, on July 27th, the gold medals for distinguished merit were awarded to Sir Walter Foster and Mr. C. G. Wheelhouse. The Stewart prize was awarded to Dr. G. S. Woodhead, and the Middlemore prize to Dr. Alexander Hill Griffith.

THE Yerkes Observatory of the University of Chicago will be dedicated on October 1st. The program is not yet announced, but it is planned to hold a series of conferences as part of the ceremonies, and it is hoped that a large number of astronomers and other men of science will be present.

REPLYING recently to a committee asking for the earlier opening of Kew Gardens, Mr. Akers-Douglas said the *raison d'être* of the existence of Kew Gardens was the valuable scientific work it did, and he could not be expected to do anything in the way of extending the hours during which the Gardens were open to the general public if it would interfere with that work. The financial question did not weigh with him at all, for if he were convinced that the interests of science would not suffer by the earlier opening he should endeavor to persuade the Treasury to grant any extra money required. The sole question for consideration was whether the interests of science could be combined with the desire of the people for the earlier opening, and he regretted to say that the scientific men whose opinions he had obtained were entirely opposed to the proposal. From a scientific point of view the experiment had not been a success in Edinburgh, and they had no reason to anticipate any better result at Kew.

WE have published several notices of the expedition in Central Asia under the direction of the Swedish traveler, Dr. Sven Hedin. He is now preparing the results of his explorations for publication, and is expected to present these before the Royal Geographical Society of London

early in the autumn. The Russian Geographical Society will confer its gold medal upon him.

IT is stated in *Natural Science* that under the directorship of Dr. T. Kochibe, the Geological Survey of Japan has been making good progress, and the staff has been increased. There has for some time been accumulating a collection chiefly illustrative of practical geology, and it is now proposed to build a proper geological museum in Tokyo. A short time ago some valuable phosphatic beds of Tertiary age were discovered along the northeast shore of the province of Kyushu, and Dr. Tsuneto, of the Agronomic division of the Survey, has been experimenting with the material so as to make it available for the small Japanese peasant farmers to use as manure. The organic remains in the deposit are those of marine invertebrates.

DR. W. L. ABBOT, of Philadelphia, who has made valuable donations to the Smithsonian Institution, has now given a collection of birds from the Malayan peninsula containing 1,100 birds representing over 200 species.

STANFORD UNIVERSITY has been given by the brother of the late Senator Stanford, now residing in Australia, a collection of books relating to Australia, including especially works on the geography, geology and anthropology. It consists of 2,500 bound volumes and 3,000 pamphlets.

MR. FORTESQUE FLANNERY, M. P., has announced his intention to move in the House of Commons: "That in the opinion of the House it is desirable that a department of public health be constituted and that the same be under the charge of a responsible Minister having a seat in Parliament."

A COMMITTEE, consisting of Lord Crawford, Sir Edward Thompson, Sir Benjamin Stone, Professor Meldola, Captain Abney and others, has been appointed for the purpose of forming a National Photographic Record Association, the object of which is to be the collecting and making photographic historical records of the British Isles.

AN International Congress is being arranged at Paris for the discussion of the means of preventing fires in theatres and other places of public resort.

THE New York *Evening Post* states that an extensive robbery of art works and other articles of great value has taken place at the museum of the Canton of Vaud. The museum is located in the College near the Cathedral of Lausanne, and contains natural-history collections from Aventicum and Vidy, the ancient Lausanne, and interesting antiquities from lake-dwellings, coins, medals, etc. It also contains the Cantonal Library of 60,000 volumes.

A CURIOUS robbery has occurred in Paris, a number of rabbits inoculated with the germs of diphtheria, cholera, typhus, etc., having been stolen from the Aubervilliers Hospital. These are thought to have been sold to dealers, and there was a general panic in Paris among those who had eaten rabbit!

THE British Home Office will only allow five pounds of carbide of calcium to be kept without a license. It must then be kept in separate, substantial, hermetically closed metal vessels containing not more than one pound each.

THE New York State Commission on Voting Machines, consisting of Philip T. Dodge, Professor R. H. Thurston and Mr. H. de B. Parsons, held their first meeting at Albany on July 10th, for the examination of machines to be adopted by the State.

ARRANGEMENTS have been made in Boston to give members of the fire department instruction in the nature of electricity and the uses of electrical appliances.

A NEW fire-proof building will be erected for the collections of the Pathological Institute at the University at Berlin.

AT its meeting in Washington in May, 1897, the American Physiological Society appointed a committee to consider whether the time had come for the publication of an American Journal of Physiology. The committee have reported in favor of the plan and it will undoubtedly be adopted at the next meeting of the Society. The journal, which will be devoted to investigations in physiology and allied sciences, will probably begin publication in January next and will be edited by a committee of the Society, with Dr. W. T. Porter, Harvard Medical School, as Secretary.

THE *American Naturalist* has been purchased

from the estate of the late Professor Edward D. Cope and will, beginning with the next number, be edited by Dr. Robert P. Bigelow, instructor in biology in the Massachusetts Institute of Technology, assisted by an editorial committee and a board of associate editors whose names are not yet announced.

THE Zoological Society of Tokyo has begun the publication of *Annotationes Zoologicæ Japonensis*, under the editorship of Professor K. Mitsukuri, intended for contributions shorter than those contained in the Journal of the University. Professor Mitsukuri contributes an interesting introduction on the development of zoology in Japan, making due acknowledgment of the great services of Professors Morse and Whitman.

WE have received the first number of the second volume of the Bulletin of the Pará Museum of Natural History and Ethnology. The number, published in May of the present year, is largely devoted to the somewhat belated report of the director, Dr. Emilis A. Goldi, for 1895. There are attached to the museum a Zoological Garden and a Botanical Garden, a Library and a Meteorological Bureau. Numerous additions to these various institutions are reported during the year, the annual appropriation for the museum in 1895 being $70,000, and $12,000 each for the zoological and botanical gardens. The museum is visited daily by between 500 and 600 persons. The Bulletin further contains an account of an expedition, chiefly for archæological research on the Rio Maracá by A. P. de Lima Guedes, and four scientific papers.

THE manuscripts of the late Julius Sachs, the eminent botanist, will be edited by Professor Noll, of Bonn.

D. APPLETON & CO. announce that they will have ready for publication in the autumn the biography of Huxley prepared by his son.

LONGMANS, GREEN & CO. will shortly publish a new edition of 'Ancient Stone Implements, Weapons, and Ornaments of Great Britain' by Sir John Evans, President of the British Association. The work will be thoroughly revised, as much new material has been discovered since the first edition was published in 1872.

THE Civil Tribunal at Paris dismissed, on July 22d, the claim for 5,000f. damages preferred by the publisher of the French translation of Dr. Nansen's book against the *Correspondant*, in which Mme. Marie Dronsart reviewed Dr. Nansen's career and gave many extracts from the English version of his book.

PROFESSOR R. LYDEKKER contributes to the issue of *Nature* for July 15th an extended article entitled 'Species and Subspecies,' based upon the articles contributed to this JOURNAL by the Hon. Theodore Roosevelt and Dr. C. Hart Merriam. Professor Lydekker concludes his article with the following suggestion: "The question of the distinction between species and subspecies is undoubtedly one bristling with difficulties, and it is therefore one which in many cases is incapable of being definitely settled by an individual opinion. Although personally convinced of the advisability of using specific names in a wide sense, and employing trinomials for the designation of the nearly related forms, it may be suggested that an international committee of zoologists should be formed to discuss the question in all its bearings. Needless to say, such a committee should include representatives of both the 'splitting' and 'lumping' interests; and if the points at issue were fairly debated, with a full determination to give and take on both sides, it is difficult to believe that a working compromise between the extreme views could not be arranged. Almost anything is better than the present condition of uncertainty and discrepancy."

THE Plague Commission sent by the Austrian government to Bombay to study the disease has presented a provisional report to the Vienna Academy of Science. According to the *British Medical Journal* the Commissioners state that they had opportunities of investigating the plague clinically in 70 cases, and that they had opportunities of making pathological and bacteriological investigations on 47 bodies of persons who had died of the disease. Pathologically they say that three forms of plague can be distinguished: a septicæmic-hæmorrhagic

form, in which the whole lymphatic apparatus appears to be diseased in a peculiar manner; a septico-pyæmic form, with metastases to internal organs; and primary plague-pneumonia, a lobular pneumonia with quite characteristic appearances. The mode of entrance of the infection seems mostly to be the skin, more rarely the lungs and the tonsils, never the intestinal canal. The Yersin-Kitasato bacillus is certainly the exciting cause of the disease; it can be obtained pure from the organs as well as from the blood. The Commissioners were unable to satisfy themselves that Haffkine's serum injections had any effect. They considered it improbable that the plague could find a footing in Europe.

THE commission on the plague under the direction of Professor Koch has also issued its report. It states, according to the London *Times*, that the plague bacillus outside the human body or certain animals has very brief vitality. Pure cultures with which experiments were made were killed by sublimates at boiling temperature immediately, by mineral acids in five minutes, by a solution of 1 per cent. of carbolic acid in ten minutes, and by milk of lime exposed to sunlight in one hour. The duration of the life of the bacillus was found to be from eight to ten days at the most. Rats were found to be in the highest degree susceptible and to be spreading the plague germs and communicating them to human beings. For experiments on immunity Yersin serum was used with apes. Its protective power in the case of brown apes did not exceed eight days. Strong injections of serum proved to be of unquestionable curative efficacy. Haffkine's system of inoculation, which was applied to 1,400 patients, is said, contrary to the report of the Austrian Commission quoted above, to have showed undoubted protective results, although a number of the patients were taken ill in consequence of the inoculation.

REGULATIONS have been issued by the German government for the sale of Professor Koch's new tuberculin, under which name the new specific will be sold by chemists in phials containing one millilitre at Marks 8.50 and in phials containing five millilitres at Marks 42.50. The tuberculin will only be given to certified medical men or to those provided with an authorization from such.

A RESOLUTION has been submitted to the municipal council of Paris requiring families to furnish every two months a medical certificate stating that infants under one year have been cared for in accordance with hygienic rules.

UNIVERSITY AND EDUCATIONAL NEWS.

THE full text of the government bill with respect to the University of London is published in the issue of the *Times* for July 24th. The Commissioners are Lord Davey, Dr. Mandell, Lord Bishop of London, Lord Lister, Sir William Roberts, M.D., Sir Owen Roberts, Professor Jebb and Mr. E. H. Busk. The Commissioners are required to make statutes and regulations for the University of London in general accordance with the recommendations of the Cowper Commission. The Commissioners are to be superseded at the end of 1898 by a Senate of the University consisting of the Chancellor and other representative members. The Senate has entire conduct of the University, it only being provided that:

(*a*) No religious test shall be adopted, and no applicant for a University appointment shall be at any disadvantage on the ground of religious opinions;

(*b*) No procedure to a higher degree shall be allowed without examination or other adequate test, nor shall any honorary or *ad eundem* degree be conferred unless the Senate, in exceptional cases, think fit to confer such a degree on a teacher of the University;

(*c*) No disability shall be imposed on the ground of sex.

A LAW passed by the last Legislature of the State of Illinois appropriated to the State University the sum of $456,000, lost to the University by the defalcation of the former Treasurer.

THE faculty of sciences of the University of Paris has been authorized to give a certificate for higher studies in physical geography.

A NEW technical school at Northwich, built by Sir Joseph Verdin at a cost of £12,000, was formerly opened on July 24th.

IT is proposed to establish at Shanghai a university for the education of the Chinese in Western art, science and literature.

DR. R. S. CURTIS, of the University of Chicago, has been elected professor of chemistry in Hobart College.

MR. JOHN P. HYLAN has been appointed instructor in experimental psychology in the University of Illinois.

DR. HOPE, lecturer on hygiene at University College, Liverpool, has been made professor.

DR. TRAUBE, Privatdocent at Berlin, has been appointed to the newly established professorship in the Technological Institute at Charlottenburg, and Dr. Adalbert Kolb, Privatdocent in chemistry in the Technological Institute at Darmstadt, has been promoted to a professorship.

DISCUSSION AND CORRESPONDENCE.

CEREBRAL LIGHT.

IN SCIENCE for July 23d, p. 138, I find a letter from Dr. Scripture in which he makes some very acute observations on the the origin of the figures, usually irregular and obscure, but sometimes quite definite, which are seen in the dark field of the closed eyes. In past years I have spent many hours in studying these figures and they are briefly described in my little volume on Sight, pp. 66 and 67 of last edition. They are usually considered as of retinal origin and sometimes spoken of as 'retinal light;' but Dr. Scripture gives what he thinks conclusive reasons for thinking that they are of cerebral origin, and therefore proposes the name 'cerebral light.' Now, as to the question of origin, I am not prepared to say anything. I wish now only to show that his supposed tests are not valid.

1. He says that with the eyes closed there is but *one* dark field, instead of two, as there ought to be if its origin is retinal; for there are two retinæ. Now, if he means the simple field without reference to the figures in it, I would ask: How could there be more than one? Even with the eyes open, there seems to be but one field. Only by close observation can we see that there are really two partly overlapping fields forming a common field bounded on the two sides by the faint images of the nose. But in the dark field there are no images of the nose. But if, on the other hand, he means that the two retinæ could not be expected to be similarly affected in all parts, and therefore there ought to be different figures for the two retinæ in the same dark field, then I would ask again: How are we to distinguish the figures belonging to each retina in the one dark field?

2. But, in further proof, he says: These figures do *not move* with the movements of the eye; while after-images, which are admittedly retinal affections, do thus move. Now, I find, on the contrary, that these figures behave exactly as the after-images do. I find that, in looking in a different direction in the dark field, they may indeed disappear, but only to reappear at the new point of sight. After-images do the same. Unless they are very strong, they also, on changing the point of sight, disappear to reappear at the new point.

It is possible, however, that we are talking about different things. It is possible that there are two different kinds of figures in the dark field, one retinal and the other cerebral.

3. But, again, he says that these figures do not change place when the axis of the eye is displaced by pressure in the corner, whereas after-images do change place under these conditions. Now, on the contrary, I find that after-images under these conditions do *not* change place. It is true that with the eyes open they may *seem* to move, but this is only an illusion, the result of the contrary motion of all objects in the field of view. Real objects move because their images change their places on the retina while we look in the same direction, but the retinal brands which cause after-images cannot change their places on the retina. But now shut the eyes, so that there are no objects to plague us; then we find that after-images do not move by displacement of the axis of the eyes. There is only one case (that of the previous head) in which after-images follow the motions of the eye, although it is the commonest case. It is that in which the two eyes move together in the same direction. In other words, they follow the direction of looking, not the direction of the individual eye. But in displacement of the eye-axis by pressure we do not change the direction of the *looking* of the observer.

A convenient method of proving the above is as follows: Darken the experimental room slightly by closing the windows, but leave a crack between the shutters, showing a strip of bright sky. Now gaze with *one* eye, say the right, on the crack until its image is branded on the retina. If we now turn about and look at the wall in various directions the after-image, of course, follows all the motions of the eye. Even if we shut the eye and look about the field of darkness the after-image follows all the motions of the eye. But if, with eyes still shut and looking straight in front, without changing the direction of looking, we press in the external corner of the branded eye the after-image does not move. It still remains directly in front.

We have given this experiment as most convenient, but we may use a retinal brand produced by the setting sun with still more conspicuous results.

One more experiment to show the behavior of after-images in the movements of the eye. Gaze with *both* eyes on the crack of the previous experiment, until its image is strongly banded on the vertical meridian of both retinæ. On turning about and looking at the wall the after-image is distinctly seen and follows with exactness all the motions of the eyes in looking about. But now *converge* the eyes until they look at the root of the nose. Of course, each eye changes its direction at least forty-five degrees, but the direction of the after-image does not change. It is still directly in front. The reason is that, while each eye *individually* changes its direction, the binocular observer looks in the same direction, though at a nearer point. The two external images of the retinal brands cannot separate, as the images of an object do, because the brands are on corresponding points and have the same spatial representative and, therefore, must be seen single. This is the reason, as I have fully explained in my volume 'Sight,' pp. 199 and 200, why after-images cannot be used to test the motions of the eyes by rotation on the optic axis in *convergence*, although they are such accurate tests in *parallel motion*.

JOSEPH LE CONTE.

BERKELEY, CAL., July 29, 1897.

SCIENTIFIC LITERATURE.

Leitfaden der Praktischen Physik, mit einem Anhange, Das absolute Maas-system. VON F. KOHLRAUSCH. Achte Auflage, B. G. Teubner, Leipzig.

Each new edition of this book has been characterized by such considerable additions that the modest guide to elementary laboratory work in physics, which first appeared under this title more than twenty-five years ago, has become a reference volume of some five hundred pages, as valuable to the advanced worker as to the beginner.

A laboratory manual should cover the entire field without undue specialization in any one direction, and without any omissions. Kohlrausch's book does this for physics more satisfactorily than any other. In fact, the manuals edited in America are too evidently, and often avowedly, nothing more than a compilation from the course given at the particular institution at which the author is teaching, and hence possess all the peculiarities and limitations of the work at that laboratory, and too often are of slight value elsewhere, with different conditions and facilities.

Kohlrausch sets forth not what is done at Würzburg or Strasburg, or even at Berlin, but what ought to be done under ideal conditions in a complete laboratory. The book is a guide to the instructor as to what experiments should be performed, as well as to the student as to how they are to be performed.

As regards the explanation of the operations, the author seems to have followed most successfully the principle laid down in the preface to this edition, "to carry the scheme, the explanation, and the setting-up of the apparatus for an experiment no further than is rendered necessary for the successful operation of a laboratory attended by a large number of students." He has achieved the happy mean between allowing the pupil to flounder too long in the working out of an experiment, and giving him such minute instructions that the necessity for originality of thought on his part is entirely eliminated.

It is difficult to select parts of this book as worthy of special mention, and yet certain subjects are treated in a manner in especially

agreeable contrast to that found in similar manuals. The calculation of corrections and the discussion of the effect of the errors of observation upon the result, as well as the methods of least squares and of approximation, will be found particularly clear, complete and useful. Indeed, much of the unique value of the book lies in its many suggestions as to simple manipulative methods, receipts and general good advice. It is these little 'tricks of the trade' that distinguish the successful experimental investigator from the helpless theorizer.

The body of the book contains concise, clear instructions for the determination of about every quantity that may be of interest to the experimental physicist, together with numerous demonstrations and illustrative examples. An excellent feature of this part is the frequent reference to the original investigations from which the methods were derived.

The absolute system of units is happily not the novelty to-day that it was when Kohlrausch introduced it into the Leitfaden; nevertheless his clear and complete exposition of its principles, its units and their values is very acceptable even now, and gives in some twenty pages the essentials of the whole matter.

The thirty pages of carefully selected tables form a very agreeable and striking contrast to some similar books recently offered in this country.

Some teachers have lamented the absence of pictures of instruments, but it would appear inconsistent with the general nature of the book if specific pieces of apparatus were represented. It is better and probably easier for a pupil to specialize from a diagram to any corresponding instrument than from one instrument to another of radically different appearance, though similar in principle.

The English translation of the last edition of Kohlrausch is very good, but not so good as the original because the translator has permitted himself to make changes.

A Systematic Treatise on Electrical Measurements. By HERSCHEL C. PARKER. Spon & Chamberlain, London and New York.

Mr. Parker, confining himself to a smaller field, and rather to the technical than the theoretical aspect of the subject, has succeeded in following the good example of Kohlrausch and sets forth what such a course should teach, rather than what is taught under the conditions at Columbia.

Particularly valuable is the strictly systematic way in which the subject is treated, enabling the student to see at a glance the relative merits of different instruments and methods for the various measurements of the same class, and to choose the apparatus and method best adapted to his particular determination. Although giving the principle and construction of the latest forms of electrical measuring instruments, the author has done better than some others, who could not resist the temptation to use old cuts or introduce trade pictures of apparatus. His diagrams and outline cuts show the fundamental parts most satisfactorily and enable the reader easily to imagine the brass and hard-rubber accompaniments. The book is sure to be useful to the electrical engineer, as well as to the investigator, who will gladly welcome future editions with the revision and additions which the author seems to feel desirable.

WILLIAM HALLOCK.

Bibliography—A Study of Resources. CHARLES SEDGWICK MINOT. In *Biological Lectures delivered at the Marine Biological Laboratory of Wood's Holl in the summer session of 1895.* Boston, Ginn & Company. 1896. P. 149–168.

Short surveys of the present standpoint of bibliography from the point of view of the special sciences should prove advantageous both for the specialist and for the bibliographer. To the former such surveys would be mainly useful in giving him a systematic guide through the mass of publications which he must work over to find the particular literature needed for his investigations. To the latter—I am here thinking especially of the librarian—they would make plain the connection of bibliography with the special sciences of which bibliography is the handmaid. Professor Minot's account of biological bibliographical literature is a good example of what such a survey should be. He does not drown his subject in enumeration of details, but describes and considers the main

guides to biological literature. One could wish to have as an appendix to the lecture a list, with full bibliographical details, of the publications treated, showing especially the connection and succession of the numerous German *Jahresberichte* and *Anzeiger*. As it is, however, the lecture makes not only an admirable introduction to biological bibliography, but also very interesting reading. The bulk of the lecture is devoted to the bibliographical publications in question, which are divided into four classes: (1) Standard bibliographies; (3) Incidental bibliographies; (3: a.) Current bibliographies appearing annually; (3: b.) Current bibliographies appearing at intervals of less than a year. As an introduction Professor Minot gives an interesting account of his own methods of dealing bibliographically with his literary material and with his library. In connection herewith he also gives some few rules for dealing with a scientific subject from the point of view of the bibliographer, emphasizing that the *title* of an article 'should be as brief as possible and nevertheless indicate the contents;' that *a table of contents* should be used in longer articles, say of 40 to 100 pages; that *reprints* should have the paging of the original publications; and that *references to other authorities* should be carefully arranged.

AKSEL G. S. JOSEPHSON.

THE JOHN CRERAR LIBRARY, CHICAGO.

Indiana—A Century of Changes in the Aspects of Nature. A. W. BUTLER. President's Address. From Proceedings Indiana Academy of Sciences, No. V., 1895.

This pamphlet of a dozen pages gives an interesting account of the changes in the natural conditions in Indiana, brought about by the advent of the white man, the passing away of the virgin forests, the destruction of the herds of buffaloes, the elk, the flocks of wild turkeys, the pigeons and many more.

In the valleys of the Wabash and Whitewater there were magnificent forests of deciduous trees, which probably could not be surpassed anywhere in America. Forty-two trees in the Wabash valley attained a height above one hundred feet, the tallest recorded being a tulip poplar (*Liriodendron tulipifera L.*), 190 feet high. The bison or buffaloes had well marked roadways in some of the river valleys, along which countless thousands passed annually, chiefly on their journey to and from the Big Bone Lick, in Kentucky. Elk and deer were common, bear and wolves quite abundant, beaver were found in many localities, while the wild cat Canada porcupine and panther were numerous. Wild turkeys and pigeons and the beautiful little Carolina paroquets were more than abundant, but have been almost, or in a great measure, exterminated. The hog assisted in the killing of the rattlesnakes and copperheads.

Thus, with the aid of the gun, of fire and the axe, was the land, all things being considered, speedily made ready for the plow, and a new life of sparrows, of little snakes, humble bees and grasshoppers took possession of the fields. More than half of humanity will declare that the destruction was unavoidable and even commendable, but we trace a spirit of regret running through all of Mr. Butler's admirable address, and this speaks for the rest of mankind, who would fain have saved a tract of virgin forest where they might resort to contemplate some of the wonders of the world.

W. T. DAVIS.

NEW BOOKS.

System der Bakterien. W. MIGULA. Jena, Gustav Fischer. 1897. Pp. viii + 368 and 6 plates.

Citizen Bird. MABEL OSGOOD WRIGHT and ELLIOTT COUES. New York and London, The Macmillan Company. 1897. Pp. xiv + 419. $1.50.

Some Unrecognized Laws of Nature. IGNATIUS SINGER and LEWIS H. BERENS. New York, D. Appleton & Co. 1897. Pp. xvi + 511. $2.50.

Les huiles Minérales. FRANÇOIS MIRON. Paris, Gauthier-Villars et fils. Pp. 194.

Bulletin de la Société Belge de Geologie de Paléontologie et Hydrologie. ANNÉE. 1895. Vols. IX and X. Brussels, Polleunis et Centerick. 1895, '96, '97.

The University Geological Survey of Kansas. ERASMUS HAWORTH. Topeka. 1897. Vol. II. Pp. 318.

Alfred M. Mayer

SCIENCE

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Friday, August 20, 1897.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

ALFRED MARSHALL MAYER.

A man of science, whose work was unique in the domain which he had selected, and who will long be held in warm remembrance by a large circle of friends, has lately passed away.

In 1784 there emigrated to America a young German, Christian Mayer, a member of an ancient family in the city of Ulm, in Würtemberg. He made his home in Baltimore, where, by strong intelligence and well directed industry, he amassed a fortune. To his two sons, Charles F. and Brantz, he gave the best educational advantages of the day. The former became a prominent lawyer, well known in the best social circles of Baltimore on account of his refinement and broad literary culture, while the latter traveled and wrote extensively, his historical work, especially in connection with Mexico, being of high authority and acknowledged value.

On the thirteenth day of November, 1836, a son was born to Charles F. Mayer. At an early age the boy exhibited great mechanical ingenuity and a lively interest in the external world of nature. At St. Mary's College, in Baltimore, he was afforded all the usual facilities for an elementary liberal education, and especially for classical training; but this did not suit his native bent. At the age of sixteen years he gave up the school room, and the following two years were spent chiefly in the workshop and the draughting room of a mechanical engineer. Here was abundant opportunity for acquiring familiarity with the use of tools and developing manipulative skill. At the same time there was a continual stimulus to private study in connection with the daily application of the laws of physics and mechanics. This course of study in applied science was a natural precursor to the resumption of more systematic work, not in the class room, but in the laboratory. A course of

chemistry was undertaken, and two years were spent largely in mastering the principles and processes of quantitative analysis.

It was during these years of private study and practical work that young Mayer attracted the attention of a man whose personal influence was chiefly instrumental in determining the future direction of the student's energies. Joseph Henry was at this time Secretary of the Smithsonian Institution, and for thirty years he had been identified with the advancement of pure science in America. Industrial science needs no advocates. Its importance is recognized by all. Its immediate connection with material progress and its quick response to commercial demands are sufficient to bring within the ranks of its devotees the great majority of those who undertake laboratory work with a definite purpose. Henry had never underrated the value or the need of industrial science, but he had emphasized the importance of investigation from the more unselfish standpoint of one who regarded intellectual acquisition as a priceless good in itself apart from all commercial recompense. He apprehended the brightness, the alertness, the originality of the Baltimore student, and accorded him that sympathetic recognition which constitutes the greatest stimulus that a young man can receive. The friendship of an acknowledged master makes a willing and easily directed pupil. Ideals of excellence are thus formed for life. Subsequent experience may sometimes modify these, but they are rarely ever discarded.

At the early age of twenty years Mayer was appointed to the chair of physics and chemistry in the University of Maryland. He had already during the previous year published his first contribution to science, the description of a 'new apparatus for the determination of carbonic acid.' This was soon republished in Germany. His new duties absorbed now most of his time, but a second paper appeared in the *American Journal of Science*, in 1857, on the estimation of the weights of very small portions of matter. In this he showed that by the deflection of a fine glass fibre it is possible to estimate a variation in weight so small as the thousandth part of a milligram. In 1859 he accepted a chair in Westminster College, Missouri, where two years were spent; but the equipment of this institution was insignificant and no original work was accomplished. The breaking out of the Civil War determined his return to Baltimore, and in 1863 he went to Paris, where two years were occupied in special study, chiefly under the direction of Regnault. The influence of the great French physicist, and the general atmosphere of the University of Paris, strengthened the bias in favor of pure science which had been received in youth from Henry.

Soon after his return to America, in 1865, Professor Mayer was called to the chair of physics and chemistry at Pennsylvania College, in Gettysburg, which he gave up, in 1867, to accept that of physics and astronomy in Lehigh University. This in turn was renounced in 1871 for the purpose of joining in the upbuilding of the new Stevens Institute of Technology, at Hoboken, with which his connection continued up to the time of his death, July 13, 1897. It is with this institution, therefore, that his name will always be chiefly identified, though his researches were for the most part in channels somewhat removed from those that are usually characteristic of an engineering school. Its instrumental equipment was unusually good, and proximity to a great metropolis afforded the intellectual stimulus and the prompt recognition of merit which are wanting in isolated institutions of learning.

While connected with Lehigh University,

Professor Mayer designed an astronomical observatory and superintended its construction. He erected the instruments and, without assistance, finished the tedious work of adjusting them. A series of observations on Jupiter followed, and its publication was reproduced in England. During the summer vacation of 1869 he was deputed by the United States government to take charge of a party of astronomers at Burlington, Iowa, where the solar eclipse of August 7th was observed. During the eclipse more than forty successful photographs were taken, each exposure lasting 0.002 second. Four of these were during the eighty-three seconds of totality. This was in the early days of instantaneous photography and was accounted an unusual feat. An abstract of the results of measurements on these photographs was published in the Journal of the Franklin Institute. In the same journal, about this time, he published a number of articles on physical and astrophysical subjects. At the Salem meeting of the Scientific Association, 1869, a paper was read 'On the thermodynamics of waterfalls.' At Trenton Falls and at Niagara Falls careful observations had been made on the temperature of the water at the top of the cataract and just beyond the point of impact at the bottom. The arrest of motion develops heat, and this was found to be manifested in a measurable rise of temperature, when the air was charged with moisture and not much warmer or colder than the water, the change being in accordance with calculation based on Joule's equivalent. But under other conditions this effect was masked to such an extent by the cooling effect of evaporation and conduction that there was sometimes a lower temperature at the bottom than at the top.

Soon after entering upon his duties at Hoboken, Professor Mayer began the series of investigations in acoustics for which he is perhaps best known, and which made him decidedly the leading authority on this subject in America. In the first of his papers he showed how the co-vibration of two nearly unisonant tuning forks may be utilized to demonstrate Doppler's well-known principle that wave-length may be modified by translation of the vibrating body. This was soon followed by another paper in which he gave a method of detecting the phases of vibration in the air surrounding a sounding body. Two resonators responding to the pitch of the source were employed, each connected with a manometric capsule. One of these resonators being fixed and the other movable, the recurring changes in the compound flame image gave the means of measuring wave-lengths directly in the vibrating air and exploring the form of the wave surface. A simple and precise method was developed from this for measuring wave-lengths and velocities of sound in gases at various temperatures; and an acoustic pyrometer was devised by which furnace temperatures were capable of measurement with a degree of accuracy approaching that of the air thermometer. The same optical method of interference was then further applied to the determination of the relative intensities of sounds. The range of application of this method is somewhat limited, but within this range it is more precise than any other method devised for the same purpose. One application was to the measurement of the powers of various substances to transmit and to reflect sonorous vibrations. An investigation of the relative absorbing powers of different media for sound led to an approximate determination of the mechanical equivalent of an aërial sonorous vibration. The energy per second given forth in aërial vibrations by an Ut_3 fork (256 vd.), set in motion by intermittent electro-magnetic action and placed before an appropriate resonator, was

found to be about one millionth of Joule's unit, or enough to raise one gram through a height of ten centimeters. This result was accomplished by measuring the relative intensities of the sound given forth by the same fork, first when vibrating freely, then when the motion of its prongs was damped by the expenditure of part of its energy on india rubber. The rise of temperature of the rubber was measured by use of thermopile and galvanometer, and its specific heat determined by ordinary methods. The difficulties attendant upon such an experiment are very great, and no one but an experimentalist of exceptional skill and patience would be apt to undertake it.

These strictly physical investigations led Professor Mayer into the domain of physiology in its bearing upon the phenomena of audition. The most important principle in acoustics is that of harmonic motion, simple and compound, as embodied in Fourier's theorem. Helmholtz was the first to apply this to the analysis of musical quality, and in doing so the subjective method of resonators was utilized with great skill. Professor Mayer sought objective methods and devised several of these, the most striking of which was that of employing tense threads as media for the conveyance of energy from a vibrating membrane to mounted tuning forks adjusted in pitch to respond to the components of the compound sound under examination. Recognizing the capacity of the ear, when sufficiently trained, to accomplish this analysis to a considerable extent without instrumental aid, he sought to learn the mechanism of the auditory apparatus of some of the lower types of animal life. Some new and interesting facts were thus discovered in relation to the function of the antennæ of the mosquito in audition, and he showed how an insect may determine the direction of sounds by means of its antennæ. In this connection good reason was found for the belief that the terminal auditory nerve fibrils in the human ear vibrate just half as often in a given time as the membrane of the tympanum and the ossicles. This hypothesis partially accounts for the marked difference in quality when the same sound is successively heard, first directly through the open ear and then through the medium of the bony portions of the head.

Professor Mayer's most important acoustic research was his determination of the law connecting the pitch of a sound with the duration of the residual sensation in the ear. An explanation of the method adopted cannot be here given without entering unduly into details. This law gave a quantitative character to results which Helmholtz had attained only qualitatively. It is of fundamental importance in its application to musical harmony. It explains why certain combinations of tones which are harmonious in the upper portions of the musical scale become rough and discordant in the lower portions. This mere fact the musical composer was long compelled to recognize, though hitherto it had been inexplicable. The labor involved in this work was great, and before its completion the investigator's power of audition in one ear was thereby permanently impaired. The first experiments were published in 1874; a redetermination was made in 1875, and again with improved apparatus in 1893. He received the assistance of the most accomplished musical experts, including Madame Seiler, who had been associated with Helmholtz for a somewhat similar purpose, and Dr. Rudolph Koenig, of Paris, whose training in the detection of musical beats is unrivaled. Dr. Koenig, in 1893, rendered important service in ascertaining the limitations of what may now be properly called 'Mayer's Law.' This law is expressed by an equation in which the duration of the residual sensation is given as a function of vibration frequency, and

this equation is readily translated into a curve. Between the limits of 100 and 4,000 vibrations per second there is closer accordance between the results of calculation and observation than in the case of Fechner's law, or indeed any other physiological law for which the attempt has been made to express sensation mathematically. Between 200 and 2,000 vibrations, including the range most constantly resorted to in music, the accordance is satisfactory, even when measured by physical rather than physiological standards. Due recognition of these important contributions to acoustic theory have been made by Mr. Ellis in his translation of Helmholtz's 'Tonempfindungen,' and by Professor Zahm in his recent book (1892) on 'Sound and Music.' Mr. Ellis gave a special lecture in London for the purpose of explaining these discoveries and their application to the principles of musical harmony.

It was natural for Professor Mayer to apply acoustic methods in work primarily undertaken for other purposes. In 1876 he devised improvements in what is now generally known as the electrographic method for the measurement of the velocity of projectiles and the determination of pitch. He utilized the spark from an induction coil for the purpose of marking seconds upon the sinuous trace of a tuning fork on smoked paper, and attained results of great accuracy. He studied with care the laws of vibration of tuning forks, and was the first to give accurately the correction to be applied in all such determinations on account of variation in temperature of the fork. Between 1889 and 1894 he conducted an elaborate research on the variation of the modulus of elasticity of various materials with change of temperature, as indicated by the transverse vibration of bars. From the observed pitch the velocity of propagation of sound in the bar is found, and this gives the modulus of elasticity. For the accurate determination of pitch it was necessary to visit Paris, where access was had to Dr. Koenig's grand tonometer, and where this accomplished acoustician freely gave his time and skill in furtherance of the work. The remarkable regularity in the results shows that this acoustic method, as conducted, is worthy of the greatest reliance. Among the materials thus studied was aluminum. Its modulus was found to be subject to large variation, and in every respect it is far inferior to steel for acoustic purposes.

Among the acoustic discoveries of Professor Mayer may be mentioned his observation that the sensation of a sound may be obliterated by the simultaneous action on the ear of another sound of greater volume and lower pitch, but that the converse is not true. The higher pitch, even when intense, cannot obliterate the sensation of another sound of lower pitch. This does not imply that the higher pitch is thus always completely obliterated. Its presence modifies the compound perception after the possibility of singling it out has vanished. The apprehension of this truth caused him to suggest certain changes in the method of conducting orchestral music, but they were not adopted on account of counter-balancing inconveniences in practice.

In 1876 Professor Mayer discovered that the air pressure on the inner surface of the bottom of a resonator in action exceeds that on the corresponding outer surface. This led to the construction of the 'sound mill,' composed of pairs of resonators so balanced and pivoted on their supports as to be set into rotation by reaction on sounding near them a tuning fork to which they are adapted. This phenomenon of acoustic repulsion was shortly afterward discovered independently by Dvorâk in Austria. Another application of resonators by Professor Mayer was in the invention of the topophone, an instrument with which the direc-

tion of sound at sea, such as that of a fog horn, could be determined with a close approximation to accuracy. His last publication in acoustics was on the production of audible beat tones from two vibrating bodies whose frequencies are so high that the separate tones are inaudible. This paper was read at the Oxford meeting of the British Association in 1894. The existence of such beat tones has been doubted by some. In the present case I was associated with Professor Mayer during some of his experiments, and had previously had considerable experience in the use of the sources of sound which he employed. As to the reality of the results he claimed there cannot be the least doubt on the part of any person possessing ordinarily acute powers of hearing, who will take the trouble to repeat the experiments.

The study of the physiology of sensation tempts to the investigation of the problems of vision in connection with those of audition. During the winter and spring of 1893 Professor Mayer became much interested in the phenomena of simultaneous color contrast, of which it may yet be said that no satisfactory explanation is provided by any existing theory of color vision. It has been common to assume that the modification of color perception induced by contrast is due to unconscious motion of the observer's eyes, to error or fluctuation of judgment, or to incipient retinal fatigue. Professor Mayer devised a variety of methods of presenting these phenomena with unexampled vividness, and on so large a scale as to enable him to arrive at quantitative statements of such subjective color by comparison with standard hues with which they were matched on the revolving color disk. Vivid contrast hues were readily perceptible when the illumination was secured by means of a momentary electric flash, and with entire accordance between different observers who had been purposely misled to expect something different from what they actually perceived. The hypothesis of retinal fatigue, or fluctuation of judgment, or ocular motion, is excluded under such conditions. This psychological element of color contrast led to the development of a disk photometer for measurement of the brightness of colored surfaces. In the use of it a degree of accuracy was attained in excess of that usually found possible with the Bunsen photometer.

While still at the Lehigh University Professor Mayer began investigations on electricity, on magnetism and on heat, which were resumed from time to time during subsequent years in the intervals between his acoustic researches. His lecture notes on physics were published serially in the Journal of the Franklin Institute, and, subsequently, put into book form. He devised a zero-method of comparing the strengths of electro-magnets and electrical conductivities, made many observations on magnetic declination, and improved on previously known methods of fixing and photographing magnetic spectra. He undertook an elaborate research on the effect of magnetization in changing the dimensions of iron and steel bars, an effect discovered by Page in 1837, investigated by Joule in 1842, and then neglected for thirty years. It was about this time that an unusually large electro-magnet was constructed for the Stevens Institute of Technology, and was employed with much effect in public lectures. One of these, entitled 'The Earth a Great Magnet,' was given by invitation of the Yale Scientific Club and, subsequently, published. In connection with it a special form of lantern galvanometer was devised for vertical projection, which attracted much notice. Another lecture demonstration which a few years afterward attracted general attention was that of the configurations formed by magnets floating vertically and subjected to the attraction of a superposed magnet.

The multiple or oscillatory character of the electric discharge from a Leyden jar was discovered by Henry in 1842. It was carefully studied afterward by Feddersen, who used a revolving mirror, and yet more fully by Rood, who employed several methods, but more particularly that of the revolving disk with radial slits. Professor Mayer, in 1874, took advantage of centrifugal action to give steadiness to a disk of blackened paper rotated rapidly between the electrodes employed for transmission of the spark. The perforations were then subjected at leisure to micrometric measurement. Since the rotation of the disk is known, the means is thus afforded for measuring the duration of the discharge and the intervals between the successive sparks which compose it. The conditions were then studied for securing the most nearly simple discharge possible. This served as the necessary antecedent to the successful employment of the induction coil in conjunction with a method previously devised for measuring minute intervals of time with the tuning fork, or rating a tuning fork by comparison with a standard clock. The combination formed an admirable chronoscope for a variety of purposes, but more especially for measuring the velocity of projectiles.

On the general subject of heat Professor Mayer published several articles. The first of these, in relation to waterfalls, has been already mentioned. In 1872 he devised a method of tracing the progress and determining the boundary of a wave of conducted heat by taking advantage of the variation in color with change of temperature which is characteristic of certain double iodides. The same method was applied three years afterward to the securing of thermographs of the isothermal lines of the solar disk. In 1890 he gave publication to a paper on the determination of the coefficient of cubic expansion of a solid from the observation of the temperature at which water in a vessel made of this solid has the same apparent volume as it has at 0° C., and on the coefficient of cubic expansion of a substance determined by means of a hydrometer made of it. The method was applied to several different substances, including brass and vulcanite. This led to a general investigation of the properties of vulcanite, which was published soon afterward. One of these properties is its remarkably large coefficient of expansion, exceeding that of mercury.

Soon after the publication of Röntgen's discovery of a new species of radiation Professor Mayer's interest in this was aroused, and in June, 1896, he published the outcome of his investigation of herapathite, which had been employed by him to test the possibility of polarizing the Röntgen rays. Formulæ were deduced for the transmissive powers of several substances for these rays, including tourmaline, herapathite, glass, aluminum and platinum.

Professor Mayer's last scientific work was an experimental investigation of the equilibrium of the forces acting in the flotation of discs and rings of metal, and an application of such rings to the determination of the measure of surface tension of liquids. The method was wholly new, and the agreement among results was remarkable. At best, it has been difficult in the past to secure reliable results in work of this kind, and the present work is fully equal, if not superior, to the best hitherto accomplished by Plateau and Quincke. It was done during the intervals between periods of acute physical suffering, and its appearance in the *American Journal of Science* for April of the present year preceded by only a few days the paralytic stroke which demonstrated that the investigator's life work was already ended.

In this brief sketch of Professor Mayer's labors but little has been said of his numerous happy devices for lecture demonstra-

tion. His restless ingenuity was ever ready for any demand, and his mechanical aptitude was so directed by a delicate æsthetic sense that he could never be satisfied with any objective proof which was not neat and simple, as well as adequate. A few of these he published from time to time. Among them may be mentioned methods of measuring the angle of inclination of the mirrors employed in Fresnel's interference experiments; of obtaining a permanent trace of the oscillation plane of the Foucault pendulum; of registering and exhibiting the vibration of rods; of deducing the fundamental laws of electric repulsion by means of the pendulum; of measuring potentials and specific inductive capacities with the spring balance electrometer; of proving Ohm's law, and of expressing electric potential as work. Many of his demonstrations in acoustics were gathered into a small volume on 'Sound,' and have thence been copied into the elementary text-books of to-day. The same may be said of a little volume on 'Light,' prepared with the cooperation of Mr. Charles Barnard. In the student laboratory he was as efficient as in the lecture room, fertile in devices and ever insistent upon a high standard of accuracy. No one knew better than he that demonstration and practice work are of insignificant value in comparison with investigation; but he kept always in mind the fact that, in America at least, the physical investigator is nearly always compelled to be in some way a teacher, and that in teaching physical science demonstration and theoretic instruction must go hand in hand. He was conscious of his skill and, naturally, took keen pleasure in exercising it successfully. That in so doing he gave pleasure and help to others is manifested by the extent to which his methods have served as models.

The manipulative skill and tactile delicacy which are so necessary as adjuncts to independence and ingenuity in the laboratory were applied with no less success by Professor Mayer in out-door recreation. Early in life he became an accomplished marksman; and during manhood, as long as good health lasted, he was an ardent and exceptionally successful sportsman. His field and laboratory interests were combined in his application of the tuning fork to the problems of gunnery. In the *Century Magazine* he published a number of articles on sporting subjects. These were incorporated, along with contributions from other sources, in a volume entitled 'Sport with Rod and Gun in American Woods and Waters.' This volume was edited by Professor Mayer, and for it he specially prepared two valuable articles, one on 'The Shot Gun,' and another on 'The Blow Gun.'

In addition to these literary labors, Professor Mayer contributed many articles to the Cyclopedias of Appleton and Johnson, besides occasional popular articles on scientific subjects for other media of publication. In acknowledgment of his earlier contributions to science the degree of Doctor of Philosophy was accorded him in 1866 by Pennsylvania College. He was admitted to membership in the National Academy of Sciences in 1872, and was a member of each of the leading scientific societies of America, besides being a corresponding member of the British Association. He served during one year, 1873, as an associate editor of the *American Journal of Science*, and during the first eight months of that year five articles from his pen appeared in its pages. The partial failure of his eyesight then necessitated cessation from all work, and a considerable part of the next scholastic year was spent in England, where his reputation had preceded him and where hospitable entertainment was accorded by the most prominent representatives of science.

In the closer circle of personal friendship it is hard to speak with impartiality while the sense of bereavement is still fresh. A man's personality penetrates into all that he does, into his writings quite as unmistakably, if less positively, than into his conversation and the atmosphere of his home. In a eulogy on Joseph Henry, to which I listened at Cambridge just seventeen years ago, Professor Mayer said: "His best eulogy is an account of his discoveries; for a man of science, as such, lives in what he has done, and not in what he has said, nor will he be remembered for what he has proposed to do." In comparing Henry with Faraday he remarked: "Each loved science more than money, and his Creator more than either." Mayer proved himself a worthy pupil of Henry, and their friendship grew in strength until broken by the last great Destroyer. His words may now be properly applied to himself. The characteristics of the gentleman, the high-toned man of honor, were born in him. They needed no cultivation beyond the natural development and confirmation which accompany the attainment of maturity. Those who were favored with his friendship need no reminder of his generosity, his ready sympathy, his quick insight and hearty appreciation, his enthusiasm verging sometimes almost upon that of boyhood.

The value of Mayer's work will be tested by time. For some parts of it he will unquestionably be long referred to as an authority by stranger as well as friend. He dwelt in an atmosphere essentially unfavorable to the spirit which directed his work, for nowhere in the world can there be found so high a degree of general civilization conjoined with so small a degree of general appreciation of pure science as in America. This may be said with full recognition of the abundant rewards here accorded to science successfully applied in industrial fields, and of the rich endowments given by wealthy individuals to some of our educational institutions. But the man who advances theoretical science in America receives not a tithe of the recognition given to the inventor who puts on the market a merchantable device which pleases the multitude. Professor Mayer would have done his scientific work to better advantage in France or Germany. But be this as it may, we who knew him in his work must now know him only in memory. To have had him as a co-worker and friend is now a sad pleasure, and one that nothing can take away.

W. LeConte Stevens.

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*ADDRESS OF THE PRESIDENT OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.**

Once more has the Dominion of Canada invited the British Association for the Advancement of Science to hold one of the annual meetings of its members within the Canadian territory, and for a second time has the Association had the honor and pleasure of accepting the proffered hospitality.

In doing so the Association has felt that, if by any possibility the scientific welfare of a locality is promoted by its being the scene of such a meeting, the claims should be fully recognized of those who, though not dwelling in the British Isles, are still inhabitants of that Greater Britain whose prosperity is so intimately connected with the fortunes of the Mother Country.

Here, especially, as loyal subjects of one beloved sovereign, the sixtieth year of whose beneficent reign has just been celebrated with equal rejoicing in all parts of her Empire; as speaking the same tongue, and as, in most instances, connected by the ties of one common parentage, we are bound together in all that can promote our common interests.

* Delivered by Sir John Evans at Toronto, August 18, 1897.

There is, in all probability, nothing that will tend more to advance those interests than the diffusion of science in all parts of the British Empire, and it is towards this end that the aspirations of the British Association are ever directed, even if in many instances the aim may not be attained.

We are, as already mentioned, indebted to Canada for previous hospitality, but we must also remember that, since the time when we last assembled on this side of the Atlantic, the Dominion has provided the Association with a President, Sir William Dawson, whose name is alike well-known in Britain and America, and whose reputation is indeed world-wide. We rejoice that we have still among us the pioneer of American geology, who, among other discoveries, first made us acquainted with the 'Air-breathers of the Coal,' the terrestrial, or, more properly, arboreal, Saurians of the New Brunswick and Nova Scotia coal-measures.

On our last visit to Canada, in 1884, our place of assembly was Montreal, a city which is justly proud of her McGill University; to-day we meet within the buildings of another of the universities of this vast Dominion, and in a city the absolute fitness of which for such a purpose must have been foreseen by the native Indian tribes when they gave to a small aggregation of huts upon this spot the name of Toronto—'the place of meetings.'

Our gathering this year presents a feature of entire novelty and extreme interest, inasmuch as the sister Association of the United States of America—still mourning the loss of her illustrious President, Professor Cope—and some other learned societies have made special arrangements to allow of their members coming here to join us. I need hardly say how welcome their presence is, nor how gladly we look forward to their taking part in our discussions and aiding us by interchange of thought. To such a meeting the term 'international' seems almost misapplied. It may rather be described as a family gathering, in which our relatives more or less distant in blood, but still intimately connected with us by language, literature and habits of thought, have spontaneously arranged to take part.

The domain of science is no doubt one in which the various nations of the civilized world meet upon equal terms, and for which no other passport is required than some evidence of having striven towards the advancement of natural knowledge. Here, on the frontier between the two great English-speaking nations of the world, who is there that does not inwardly feel that anything which conduces to an intimacy between the representatives of two countries, both of them actively engaged in the pursuit of science, may also, through such an intimacy, react on the affairs of daily life, and aid in preserving those cordial relations that have now for so many years existed between the great American Republic and the British Islands, with which her early foundations are indissolubly connected? The present year has witnessed an interchange of courtesies which has excited the warmest feelings of approbation on both sides of the Atlantic. I mean the return, to its proper custodians, of one of the most interesting of the relics of the Pilgrim Fathers, the Log of the 'Mayflower.' May this return, trifling in itself, be of happy augury as testifying to the feelings of mutual regard and esteem which animate the hearts both of the donors and of the recipients!

At our meeting in Montreal the President was an investigator who had already attained to a foremost place in the domains of physics and mathematics, Lord Rayleigh. In his address he dealt mainly with topics, such as Light, Heat, Sound

and Electricity, on which he is one of our principal authorities. His name and that of his fellow-worker, Professor Ramsay, are now and will in all future ages be associated with the discovery of the new element, Argon. Of the ingenious methods by which that discovery was made and the existence of Argon established, this is not the place to speak. One can only hope that the element will not always continue to justify its name by its inertness.

The claims of such a leader in physical science as Lord Rayleigh to occupy the Presidential chair are self-evident, but possibly those of his successor on this side of the Atlantic are not so immediately apparent. I cannot for a moment pretend to place myself on the same purely scientific level as my distinguished friend and for many years colleague, Lord Rayleigh, and my claims, such as they are, seem to me to rest on entirely different grounds.

Whatever little I may have indirectly been able to do in assisting to promote the advancement of science, my principal efforts have now for many years been directed towards attempting to forge those links in the history of the world, and especially of humanity, that connect the past with the present, and towards tracing that course of evolution which plays as important a part in the physical and moral development of man as it does in that of the animal and vegetable creation.

It appears to me, therefore, that my election to this important post may, in the main, be regarded as a recognition, by this Association, of the value of archæology as a science.

Leaving all personal considerations out of question, I gladly hail this recognition, which is, indeed, in full accordance with the attitude already for many years adopted by the Association towards anthropology, one of the most important branches of true archæology.

It is no doubt hard to define the exact limits which are to be assigned to archæology as a science and archæology as a branch of history and belles-lettres. A distinction is frequently drawn between science, on the one hand, and knowedge or learning, on the other; but translate the terms into Latin, and the distinction at once disappears. In illustration of this, I need only cite Bacon's great work on the 'Advancement of Learning,' which was, with his own aid, translated into Latin under the title '*De Augmentis Scientiarum.*'

It must, however, be acknowledged that a distinction does exist between archæology proper and what, for want of a better word, may be termed Antiquarianism. It may be interesting to know the internal arrangements of a Dominican convent in the Middle Ages; to distinguish between the different mouldings characteristic of the principal styles of Gothic architecture; to determine whether an English coin bearing the name of Henry was struck under Henry II., Richard, John or Henry III., or to decide whether some given edifice was erected in Roman, Saxon or Norman times. But the power to do this, though involving no small degree of detailed knowledge and some acquaintance with scientific methods, can hardly entitle its possessors to be enrolled among the votaries of science.

A familiarity with all the details of Greek and Roman mythology and culture must be regarded as a literary rather than a scientific qualification; and yet when among the records of classical times we come upon traces of manners and customs which have survived for generations, and which seem to throw some rays of light upon the dim past, when history and writing were unknown, we are, I think, approaching the boundaries of scientific archæology.

Every reader of Virgil knows that the Greeks were not merely orators, but that

with a pair of compasses they could describe the movements of the heavens and fix the rising of the stars; but when, by modern astronomy, we can determine the heliacal rising of some well-known star with which the worship in some given ancient temple is known to have been connected, and can fix its position on the horizon at some particular spot, say, three thousand years ago, and then find that the axis of the temple is directed exactly towards that spot, we have some trustworthy scientific evidence that the temple in question must have been erected at a date approximately 1100 years B. C. If on or close to the same site we find that more than one temple was erected, each having a different orientation, these variations, following, as they may fairly be presumed to do, the changing position of the rising of the dominant star, will also afford a guide as to the chronological order of the different foundations. The researches of Mr. Penrose seem to show that in certain Greek temples, of which the date of foundation is known from history, the actual orientation corresponds with that theoretically deduced from astronomical data.

Sir J. Norman Lockyer has shown that what holds good for Greek temples applies to many of far earlier date in Egypt, though up to the present time hardly a sufficient number of accurate observations have been made to justify us in foreseeing all the instructive results that may be expected to arise from astronomy coming to the aid of archæology.

The intimate connection of archæology with other sciences is in no case so evident as with respect to geology, for, when considering subjects such as those I shall presently discuss, it is almost impossible to say where the one science ends and the other begins.

By the application of geological methods many archæological questions relating even to subjects on the borders of the historical period have been satisfactorily solved. A careful examination of the limits of the area over which its smaller coins are found has led to the position of many an ancient Greek city being accurately ascertained; while in England it has only been by treating the coins of the ancient Britons, belonging to a period before the Roman occupation, as if they were actual fossils, that the territories under the dominion of the various kings and princes who struck them have been approximately determined. In arranging the chronological sequence of these coins, the evolution of their types—a process almost as remarkable, and certainly as well defined, as any to be found in nature—has served as an efficient guide. I may venture to add that the results obtained from the study of the morphology of this series of coins were published ten years before the appearance of Darwin's great work on the 'Origin of Species.'

When we come to the consideration of the relics of the early Iron and Bronze Ages the aid of chemistry has, of necessity, to be invoked. By its means we are able to determine whether the iron of a tool or weapon is of meteoritic or volcanic origin, or has been reduced from iron-ore, in which case considerable knowledge of metallurgy would be involved on the part of those who made it. With bronze antiquities the nature and extent of the alloys combined with the copper may throw light not only on their chronological position, but on the sources whence the copper, tin and other metals of which they consist were originally derived. I am not aware of there being sufficient differences in the analyses of the native copper, from different localities in the region in which we are assembled, for Canadian archæologists to fix the sources from which the metal was obtained which was used in the manufacture of the ancient tools and weapons of copper that are occa-

sionally discovered in this part of the globe.

Like chemistry, mineralogy and petrology may be called to the assistance of archæology in determining the nature and source of the rocks of which ancient stone implements are made; and, thanks to researches of the followers of those sciences, the old view that all such implements formed of jade and found in Europe must, of necessity, have been fashioned from material imported from Asia can no longer be maintained. In one respect the archæologist differs in opinion from the mineralogist, namely, as to the propriety of chipping off fragments from perfect and highly finished specimens for the purpose of submitting them to microscopic examination.

I have hitherto been speaking of the aid that other sciences can afford to archæology when dealing with questions that come almost, if not quite, within the fringe of history, and belong to times when the surface of our earth presented much the same configuration as regards the distribution of land and water, and hill and valley, as it does at present, and when, in all probability, the climate was much the same as it now is. When, however, we come to discuss that remote age in which we find the earliest traces that are at present known of man's appearance upon earth the aid of geology and paleontology becomes absolutely imperative.

The changes in the surface configuration and in the extent of the land, especially in a country like Britain, as well as the modifications of the fauna and flora since those days, have been such that the archæologist pure and simple is incompetent to deal with them, and he must either himself undertake the study of these other sciences or call experts in them to his assistance. The evidence that man had already appeared upon the earth is afforded by stone implements wrought by his hands, and it falls strictly within the province of the archæologist to judge whether given specimens were so wrought or not; it rests with the geologist to determine their stratigraphical or chronological position, while the paleontologist can pronounce upon the age and character of the associated fauna and flora.

If left to himself the archæologist seems too prone to build up theories founded upon form alone, irrespective of geological conditions. The geologist, unaccustomed to archæological details, may readily fail to see the difference between the results of the operations of nature and those of art, and may be liable to trace the effects of man's handiwork in the chipping, bruising and wearing which in all ages result from natural forces; but the united labors of the two, checked by those of the paleontologist, cannot do otherwise than lead towards sound conclusions.

It will, perhaps, be expected of me that I should on the present occasion bring under review the state of our present knowledge with regard to the antiquity of man; and probably no fitter place could be found for the discussion of such a topic than the adopted home of my venerated friend, the late Sir Daniel Wilson, who first introduced the word 'prehistoric' into the English language.

Some among us may be able to call to mind the excitement not only among men of science, but among the general public, when, in 1859, the discoveries of M. Boucher de Perthes and Dr. Rigollot in the gravels of the valley of the Somme, at Abbeville and Amiens, were confirmed by the investigations of the late Sir Joseph Prestwich, myself and others, and the co-existence of man with the extinct animals of the Quaternary fauna, such as the mammoth and woolly-haired rhinoceros, was first virtually established. It was at the same time pointed out that these relics belonged to a far earlier date than the ordinary stone weapons found

upon the surface, which usually showed signs of grinding or polishing, and that in fact there were two Stone Ages in Britain. To these the terms Neolithic and Paleolithic were subsequently applied by Sir John Lubbock.

The excitement was not less when, at the meeting of this Association at Aberdeen in the autumn of that year, Sir Charles Lyell, in the presence of the Prince Consort, called attention to the discoveries in the valley of the Somme, the site of which he had himself visited, and to the vast lapse of time indicated by the position of the implements in drift-deposits a hundred feet above the existing river.

The conclusions forced upon those who examined the facts on the spot did not receive immediate acceptance by all who were interested in geology and archæology, and fierce were the controversies on the subject that were carried on both in the newspapers and before various learned societies.

It is at the same time instructive and amusing to look back on the discussions of those days. While one class of objectors accounted for the configuration of the flint implements from the gravels by some unknown chemical agency, by the violent and continued gyratory action of water, by fracture resulting from pressure, by rapid cooling when hot or by rapid heating when cold, or even regarded them as aberrant forms of fossil fishes, there were others who, when compelled to acknowledge that the implements were the work of men's hands, attempted to impugn and set aside the evidence as to the circumstances under which they had been discovered. In doing this they adopted the view that the worked flints had either been introduced into the containing beds at a comparatively recent date, or if they actually formed constituent parts of the gravel then that this is a mere modern alluvium resulting from floods at no very remote period.

In the course of a few years the main stream of scientific thought left this controversy behind, though a tendency to cut down the lapse of time necessary for all the changes that have taken place in the configuration of the surface of the earth and in the character of its occupants since the time of the Paleolithic gravels, still survives in the inmost recesses of the hearts of not a few observers.

In his address to this Association at the Bath meeting of 1864, Sir Charles Lyell struck so true a note that I am tempted to reproduce the paragraph to which I refer:

"When speculations on the long series of events which occurred in the glacial and post-glacial periods are indulged in, the imagination is apt to take alarm at the immensity of the time required to interpret the monuments of these ages, all referable to the era of existing species. In order to abridge the number of centuries which would otherwise be indispensable, a disposition is shown by many to magnify the rate of change in prehistoric times by investing the causes which have modified the animate and inanimate world with extraordinary and excessive energy. It is related of a great Irish orator of our day that when he was about to contribute somewhat parsimoniously towards a public charity he was persuaded by a friend to make a more liberal donation. In doing so he apologized for his first apparent want of generosity by saying that his early life had been a constant struggle with scanty means, and that 'they who are born to affluence cannot easily imagine how long a time it takes to get the chill of poverty out of one's bones.' In like manner, we of the living generation, when called upon to make grants of thousands of centuries in order to explain the events of what is called the modern period, shrink naturally at first from making what seems so lavish an expenditure of past time. Throughout our early education we have

been accustomed to such strict economy in all that relates to the chronology of the earth and its inhabitants in remote ages, so fettered have we been by old traditional beliefs, that even when our reason is convinced, and we are persuaded that we ought to make more liberal grants of time to the geologist, we feel how hard it is to get the chill of poverty out of our bones."

Many, however, have at the present day got over this feeling, and of late years the general tendency of those engaged upon the question of the antiquity of the human race has been in the direction of seeking for evidence by which the existence of man upon the earth could be carried back to a date earlier than that of the Quaternary gravels.

There is little doubt that such evidence will eventually be forthcoming, but, judging from all probability, it is not in northern Europe that the cradle of the human race will eventually be discovered, but in some part of the world more favored by a tropical climate, where abundant means of subsistence could be procured, and where the necessity for warm clothing did not exist.

Before entering into speculations on this subject, or attempting to lay down the limits within which we may safely accept recent discoveries as firmly established, it will be well to glance at some of the cases in which implements are stated to have been found under circumstances which raise a presumption of the existence of man in pre-Glacial, Pliocene, or even Miocene times.

Flint implements of ordinary Paleolithic type have, for instance, been recorded as found in the eastern counties of England, in beds beneath the chalky boulder clay; but on careful examination the geological evidence has not, to my mind, proved satisfactory, nor has it, I believe, been generally accepted. Moreover, the archæological difficulty that man, at two such remote epochs as the pre-Glacial and the post-Glacial, even if the term Glacial be limited to the chalky boulder clay, should have manufactured implements so identical in character that they cannot be distinguished apart seems to have been entirely ignored.

Within the last few months we have had the report of worked flints having been discovered in the late Pliocene Forest Bed of Norfolk, but in that instance the signs of human workmanship upon the flints are by no means apparent to all observers.

But such an antiquity as that of the Forest Bed is as nothing when compared with that which would be implied by the discoveries of the work of men's hands in the Pliocene and Miocene beds of England, France, Italy and Portugal, which have been accepted by some geologists. There is one feature in these cases which has hardly received due attention, and that is the isolated character of the reputed discoveries. Had man, for instance, been present in Britain during the Crag Period, it would be strange, indeed, if the sole traces of his existence that he left were a perforated tooth of a large shark, the sawn rib of a manatee, and a beaming full face, carved on the shell of a pectunculus!

In an address to the Anthropological Section at the Leeds meeting of this Association in 1890 I dealt somewhat fully with these supposed discoveries of the remains of human art in beds of Tertiary date, and I need not here go further into the question. Suffice it to say that I see no reason why the verdict of 'not proven' at which I then arrived should be reversed.

In the case of a more recent discovery in Upper Burma, in beds at first pronounced to be Upper Miocene, but subsequently 'definitely ascertained to be Pliocene,' some of the flints are of purely natural and not artificial origin, so that two questions arise: First, were the fossil remains associ-

ated with the worked flints or with those of natural forms? And second, were they actually found in the bed to which they have been assigned, or did they merely lie together on the surface?

Even the *Pithecanthropus erectus* of Dr. Eugène Dubois from Java meets with some incredulous objectors from both the physiological and the geological sides. From the point of view of the latter the difficulty lies in determining the exact age of what are apparently alluvial beds in the bottom of a river valley.

When we return to Paleolithic man it is satisfactory to feel that we are treading on comparatively secure ground, and that the discoveries of the last forty years in Britain alone enable us to a great extent to reconstitute his history. We may not know the exact geological period when first he settled in the British area, but we have good evidence that he occupied it at a time when the configuration of the surface was entirely different from what it is at present; when the river valleys had not been cut down to anything like their existing depth; when the fauna of the country was of a totally different character from that of the present day; when the extension of the southern part of the island seaward was in places such that the land was continuous with that of the continent, and when in all probability a far more rainy climate prevailed. We have proofs of the occupation of the country by man during the long lapse of time that was necessary for the excavation of the river valleys. We have found the old floors on which his habitations were fixed; we have been able to trace him at work on the manufacture of flint instruments, and by building up the one upon the other the flakes struck off by the primæval workman in those remote times we have been able to reconstruct the blocks of flint which served as his material.

That the duration of the Palæolithic Period must have extended over an almost incredible length of time is sufficiently proved by the fact that valleys, some miles in width and of a depth of from 100 to 150 feet, have been eroded since the deposit of the earliest implement-bearing beds. Nor is the apparent duration of this period diminished by the consideration that the floods which hollowed out the valleys were not in all probability of such frequent occurrence as to teach Palæolithic man by experience the danger of settling too near to the streams, for had he kept to the higher slopes of the valley there would have been but little chance of his implements having so constantly formed constituent parts of the gravels deposited by the floods.

The examination of British cave-deposits affords corroborative evidence of this extended duration of the Paleolithic Period. In Kent's Cavern, at Torquay, for instance, we find in the lowest deposit, the breccia below the red cave-earth, implements of flint and chert corresponding, in all respects, with those of the high level and most ancient river gravels. In the cave-earth these are scarcer, though implements occur which also have their analogues in the river deposits; but, what is more remarkable, harpoons of reindeer's horn and needles of bone are present, identical in form and character with those of the caverns of the Reindeer Period in the south of France, and suggestive of some bond of union or identity of descent between the early troglodytes, whose habitations were geographically so widely separated the one from the other.

In a cavern at Creswell Crags, on the confines of Derbyshire and Nottinghamshire, a bone has, moreover, been found engraved with a representation of parts of a horse in precisely the same style as the engraved bones of the French caves.

It is uncertain whether any of the river-

drift specimens belong to so late a date as these artistic cavern-remains, but the greatly superior antiquity of even these to any Neolithic relics is testified by the thick layer of stalagmite which had been deposited in Kent's Cavern before its occupation by men of the Neolithic and Bronze Periods.

Towards the close of the period covered by the human occupation of the French caves there seems to have been a dwindling in the number of the larger animals constituting the Quaternary fauna, whereas their remains are present in abundance in the lower and, therefore, more recent of the valley gravels. This circumstance may afford an argument in favor of regarding the period represented by the later French caves as a continuation of that during which the old river gravels were deposited, and yet the great change in the fauna that has taken place since the latest of the cave-deposits included in the Paleolithic Period is indicative of an immense lapse of time.

How much greater must have been the time required for the more conspicuous change between the old Quaternary fauna of the river gravels and that characteristic of the Neolithic Period!

As has been pointed out by Professor Boyd Dawkins, only thirty-one out of the forty-eight well-ascertained species living in the post-Glacial or River-drift Period survived into pre-historic or Neolithic times. We have not, indeed, any means at command for estimating the number of centuries which such an important change indicates; but when we remember that the date of the commencement of the Neolithic or Surface Stone Period is still shrouded in the mist of a dim antiquity, and that prior to that commencement the River-drift Period had long come to an end; and when we further take into account the almost inconceivable ages that even under the most favorable conditions the excavation of wide and deep valleys by river action implies, the remoteness of the date at which the Paleolithic Period had its beginning almost transcends our powers of imagination.

We find distinct traces of river action from 100 to 200 feet above the level of existing streams and rivers, and sometimes at a great distance from them; we observe old fresh-water deposits on the slopes of valleys several miles in width; we find that long and lofty escarpments of rock have receded unknown distances since their summits were first occupied by Paleolithic man; we see that the whole side of a wide river valley has been carried away by an invasion of the sea, which attacked and removed a barrier of chalk cliffs from 400 to 600 feet in height; we find that what was formerly an inland river has been widened out into an arm of the sea, now the highway of our fleets, and that gravels which were originally deposited in the bed of some ancient river now cap isolated and lofty hills.

And yet, remote as the date of the first known occupation of Britain by man may be, it belongs to what, geologically speaking, must be regarded as a quite recent period, for we are now in a position to fix, with some degree of accuracy, its place on the geological scale. Thanks to investigations ably carried out at Hoxne in Suffolk, and at Hitchin in Hertfordshire, by Mr. Clement Reid, under the auspices of this Association and of the Royal Society, we know that the implement-bearing beds at those places undoubtedly belong to a time subsequent to the deposit of the great chalky boulder clay of the eastern counties of England. It is, of course, self-evident that this vast deposit, in whatever manner it may have been formed, could not, for centuries after its deposition was complete, have presented a surface inhabitable by man. Moreover, at a distance but little farther north, beds exist which also, though at a somewhat later date, were apparently formed under glacial con-

ditions. At Hoxne the interval between the deposit of the boulder clay and of the implement-bearing beds is distinctly proved to have witnessed at least two noteworthy changes in climate. The beds immediately reposing on the clay are characterized by the presence of alder in abundance, of hazel and yew, as well as by that of numerous flowering plants indicative of a temperate climate very different from that under which the boulder clay itself was formed. Above these beds characterized by temperate plants comes a thick and more recent series of strata, in which leaves of the dwarf arctic willow and birch abound, and which were in all probability deposited under conditions like those of the cold regions of Siberia and North America.

At a higher level and of more recent date than these—from which they are entirely distinct—are the beds containing Paleolithic implements, formed in all probability under conditions not essentially different from those of the present day. However this may be, we have now conclusive evidence that the Paleolithic implements are in the eastern counties of England of a date long posterior to that of the great chalky boulder clay.

It may be said, and said truly, that the implements at Hoxne cannot be shown to belong to the beginning rather than to some later stage of the Paleolithic Period. The changes, however, that have taken place at Hoxne in the surface configuration of the country prove that the beds containing the implements cannot belong to the close of that period.

It must, moreover, be remembered that in what are probably the earliest of the Paleolithic deposits of the eastern counties, those at the highest level, near Brandon in Norfolk, where the gravels contain the largest proportion of pebbles derived from Glacial beds, some of the implements themselves have been manufactured from materials not native to the spot, but brought from a distance, and derived in all probability either from the boulder clay or from some of the beds associated with it.

We must, however, take a wider view of the whole question, for it must not for a moment be supposed that there are the slightest grounds for believing that the civilization, such as it was, of the Paleolithic Period originated in the British Isles. We find in other countries implements so identical in form and character with British specimens that they might have been manufactured by the same hands. These occur over large areas in France under similar conditions to those that prevail in England. The same forms have been discovered in the ancient river gravels of Italy, Spain and Portugal. Some few have been recorded from Africa, and analogous types occur in considerable numbers in the south of that continent. On the banks of the Nile, many hundreds of feet above its present level, implements of the European types have been discovered; while in Somaliland, in an ancient river valley at a great elevation above the sea, Mr. Seton-Karr has collected a large number of implements formed of flint and quartzite, which, judging from their form and character, might have been dug out of the drift deposits of the Somme or the Seine, the Thames or the ancient Solent.

In the valley of the Euphrates implements of the same kind have also been found, and again farther east, in the lateritic deposits of southern India, they have been obtained in considerable numbers. It is not a little remarkable, and is at the same time highly suggestive, that a form of implement almost peculiar to Madras reappears among implements from the very ancient gravels of the Manzanares at Madrid. In the case of the African discoveries we have as yet no definite paleontological evidence by which to fix their antiquity,

but in the Narbadá valley of western India Paleolithic implements of quartzite seem to be associated with a local fauna of Pleistocene age, comprising, like that of Europe, the elephant, hippopotamus, ox and other mammals of species now extinct. A correlation of the two faunas with a view of ascertaining their chronological relations is beset with many difficulties, but there seems reason for accepting this Indian Pleistocene fauna as in some degree more ancient than the European.

Is this not a case in which the imagination may be fairly invoked in aid of science? May we not from these data attempt, in some degree, to build up and reconstruct the early history of the human family? There, in eastern Asia, in a tropical climate, with the means of subsistence readily at hand, may we not picture to ourselves our earliest ancestors gradually developing from a lowly origin, acquiring a taste for hunting, if not indeed being driven to protect themselves from the beasts around them, and evolving the more complicated forms of tools or weapons from the simpler flakes which had previously served them as knives? May we not imagine that, when once the stage of civilization denoted by these Paleolithic implements had been reached, the game for the hunter became scarcer, and that his life, in consequence, assumed a more nomad character? Then, and possibly not till then, may a series of migrations to 'fresh woods and pastures new' not unnaturally have ensued, and these, following the usual course of 'westward towards the setting sun,' might eventually lead to a Paleolithic population finding its way to the extreme borders of western Europe, where we find such numerous traces of its presence.

How long a term of years may be involved in such a migration it is impossible to say, but that such a migration took place the phenomena seem to justify us in believing. It can hardly be supposed that the process that I have shadowed forth was reversed, and that man, having originated in northwestern Europe, in a cold climate, where clothing was necessary and food scarce, subsequently migrated eastward to India and southward to the Cape of Good Hope! As yet, our records of discoveries in India and eastern Asia are but scanty; but it is there that the traces of the cradle of the human race are, in my opinion, to be sought, and possibly future discoveries may place upon a more solid foundation the visionary structure that I have ventured to erect.

It may be thought that my hypothesis does not do justice to what Sir Thomas Browne has so happily termed 'that great antiquity, America.' I am, however, not here immediately concerned with the important Neolithic remains of all kinds with which this great continent abounds. I am now confining myself to the question of Paleolithic man and his origin, and in considering it I am not unmindful of the Trenton implements, though I must content myself by saying that the 'turtle-back' form is essentially different from the majority of those on the wide dissemination of which I have been speculating, and, moreover, as many here present are aware, the circumstances of the finding of these American implements are still under careful discussion.

Leaving them out of the question for the present, it may be thought worth while to carry our speculations rather further, and to consider the relations in time between the Paleolithic and the Neolithic Periods. We have seen that the stage in human civilization denoted by the use of the ordinary forms of Paleolithic implements must have extended over a vast period of time if we have to allow for the migration of the primeval hunters from their original home, wherever it may have been in Asia

or Africa, to the west of Europe, including Britain. We have seen that, during this migration, the forms of the weapons and tools made from silicious stones had become, as it were, stereotyped, and further, that, during the subsequent extended period implied by the erosion of the valleys, the modifications in the form of the implements and the changes in the fauna associated with the men who used them were but slight.

At the close of the period during which the valleys were being eroded comes that represented by the latest occupation of the caves by Paleolithic man, when both in Britain and in the south of France the reindeer was abundant; but among the stone weapons and implements of that long troglodytic phase of man's history not a single example with the edge sharpened by grinding has as yet been found. All that can safely be said is that the larger implements as well as the larger mammals had become scarcer, that greater power in chipping flint had been attained, that the arts of the engraver and the sculptor had considerably developed, and that the use of the bow had probably been discovered.

Directly we encounter the relics of the Neolithic Period, often, in the case of the caves lately mentioned, separated from the earlier remains by a thick layer of underlying stalagmite, we find flint hatchets polished at the edge and on the surface, cutting at the broad and not at the narrow end, and other forms of implements associated with a fauna in all essential respects identical with that of the present day.

Were the makers of these polished weapons the direct descendants of Paleolithic ancestors whose occpation of the country was continuous from the days of the old river gravels? or had these long since died out, so that after western Europe had for ages remained uninhabited it was repeopled in Neolithic times by the immigration of some new race of men? Was there, in fact, a 'great gulf fixed' between the two occupations? or was there in Europe a gradual transition from the one stage of culture to the other?

It has been said that "what song the Syrens sang, or what name Achilles assumed when he hid himself among women, though puzzling questions, are not beyond all conjecture;" and though the questions now proposed may come under the same category, and must await the discovery of many more essential facts before they receive definite and satisfactory answers, we may, I think, throw some light upon them if we venture to take a few steps upon the seductive if insecure paths of conjecture. So far as I know, we have as yet no trustworthy evidence of any transition from the one age to the other, and the gulf between them remains practically unbridged. We can, indeed, hardly name the part of the world in which to seek for the cradle of Neolithic civilization, though we know that traces of what appear to have been a stone-using people have been discovered in Egypt, and that what must be among the latest of the relics of their industry have been assigned to a date some 3,500 to 4,000 years before our era. The men of that time had attained to the highest degree of skill in working flint that has ever been reached. Their beautifully made knives and spear-heads seem indicative of a culminating point reached after long ages of experience; but whence these artists in flint came or who they were is at present absolutely unknown, and their handiworks afford no clue to help us in tracing their origin.

Taking a wider survey, we may say that, generally speaking, not only the fauna, but the surface configuration of the country were, in western Europe at all events, much the same at the commencement of the Neolithic Period as they are at the present day. We have, too, no geological

indications to aid us in forming any chronological scale.

The occupation of some of the caves in the south of France seems to have been carried on after the erosion of the neighboring river valleys had ceased, and so far as our knowledge goes these caves offer evidence of being the latest in time of those occupied by man during the Paleolithic Period. It seems barely possible that, though in the north of Europe there are no distinct signs of such late occupation, yet that, in the south, man may have lived on, though in diminished numbers; and that in some of the caves, such, for instance, as those in the neighborhood of Mentone, there may be traces of his existence during the transitional period that connects the Paleolithic and Neolithic Ages. If this were really the case we might expect to find some traces of a dissemination of Neolithic culture from a north Italian center, but I much doubt whether any such traces actually exist.

If it had been in that part of the world that the transition took place, how are we to account for the abundance of polished stone hatchets found in central India? Did Neolithic man return eastward by the same route as that by which in remote ages his Paleolithic predecessor had migrated westward? Would it not be in defiance of all probability to answer such a question in the affirmative? We have, it must be confessed, nothing of a substantial character to guide us in these speculations; but, pending the advent of evidence to the contrary, we may, I think, provisionally adopt the view that, owing to the failure of food, climatal changes or other causes, the occupation of western Europe by Paleolithic man absolutely ceased, and that it was not until after an interval of long duration that Europe was re-peopled by a race of men immigrating from some other part of the globe where the human race had survived, and in course of ages had developed a higher stage of culture than that of Paleolithic man.

I have been carried away by the liberty allowed for conjecture into the regions of pure imagination, and must now return to the realms of fact, and one fact on which I desire for a short time to insist is that of the existence at the present day, in close juxtaposition with our own civilization, of races of men who, at all events but a few generations ago, lived under much the same conditions as did our own Neolithic predecessors in Europe.

The manners and customs of these primitive tribes and peoples are changing day by day, their languages are becoming obsolete, their myths and traditions are dying out, their ancient processes of manufacture are falling into oblivion, and their numbers are rapidly diminishing, so that it seems inevitable that ere long many of these interesting populations will become absolutely extinct. The admirable Bureau of Ethnology instituted by our neighbors in the United States of America has done much towards preserving a knowledge of the various native races in this vast continent, and here in Canada the annual Archæological Reports presented to the Minister of Education are rendering good service in the same cause.

Moreover, the committee of this Association appointed to investigate the physical characters, languages and industrial and social conditions of the Northwestern tribes of the Dominion of Canada is about to present its twelfth and final report, which, in conjunction with those already presented, will do much towards preserving a knowledge of the habits and languages of those tribes. It is sad to think that Mr. Horatio Hale, whose comprehensive grasp of the bearings of ethnological questions, and whose unremitting labors have so materially conduced to the success of the com-

mittee, should be no longer among us. Although this report is said to be final, it is to be hoped that the committee may be able to indicate lines upon which future work in the direction of ethnological and archæological research may be profitably carried on in this part of Her Majesty's dominions.

It is, however, lamentable to notice how little is being or has been officially done towards preserving a full record of the habits, beliefs, arts, myths, languages and physical characteristics of the countless other tribes and nations more or less uncivilized which are comprised within the limits of the British Empire. At the meeting of this Association held last year at Liverpool it was resolved by the General Committee "that it is of urgent importance to press upon the government the necessity of establishing a Bureau of Ethnology for Greater Britain, which, by collecting information with regard to the native races within and on the borders of the Empire, will prove of immense value to science and to the government itself." It has been suggested that such a bureau might, with the greatest advantage and with the least outlay and permanent expense, be connected either with the British Museum or with the Imperial Institute, and the project has already been submitted for the consideration of the trustees of the former establishment.

The existence of an almost unrivalled ethnological collection in the Museum, and the presence there of officers already well versed in ethnological research, seem to afford an argument in favor of the proposed bureau being connected with it. On the other hand, the Imperial Institute was founded with an especial view to its being a center around which every interest connected with the dependencies of the Empire might gather for information and support. The establishment, within the last twelve months of a scientific department within the Institute, with well-appointed laboratories and a highly trained staff, shows how ready are those concerned in its management to undertake any duties that may conduce to the welfare of the outlying parts of the British Empire; a fact of which I believe that Canada is fully aware. The Institute is, therefore, likely to develop, so far as its scientific department is concerned, into a bureau of advice in all matters scientific and technical, and certainly a Bureau of Ethnology, such as that suggested, would not be out of place within its walls.

Wherever such an institution is to be established, the question of its existence must, of necessity, rest with Her Majesty's government and treasury, inasmuch as without funds, however moderate, the undertaking cannot be carried on. I trust that in considering the question it will always be borne in mind that in the relations between civilized and uncivilized nations and races it is of the first importance that the prejudices, and especially the religious or semi-religious and caste prejudices, of the latter should be thoroughly well known to the former. If but a single 'little war' could be avoided in consequence of the knowledge acquired and stored up by the Bureau of Ethnology preventing such a misunderstanding as might culminate in warfare, the cost of such an institution would quickly be saved.

I fear that it will be thought that I have dwelt too long on primeval man and his modern representatives, and that I should have taken this opportunity to discuss some more general subject, such as the advances made in the various departments of science since last this Association met in Canada. Such a subject would, no doubt, have afforded an infinity of interesting topics on which to dilate. Spectrum analysis, the origin and nature of celestial bodies, photography, the connection between heat, light and elec-

tricity, the practical applications of the latter, terrestrial magnetism, the liquefaction and solidification of gases, the behavior of elements and compounds under the influence of extreme cold, the nature and uses of the Röntgen rays, the advances in bacteriology and in prophylactic medicine, might all have been passed under review, and to many of my audience would have seemed to possess greater claims to attention than the subject that I have chosen.

It must, however, be borne in mind that most, if not indeed all, of these topics will be discussed by more competent authorities in the various Sections of the Association by means of the Presidential addresses or otherwise. Nor must it be forgotten that I occupy this position as a representative of archæology, and am therefore justified in bringing before you a subject in which every member of every race of mankind ought to be interested—the antiquity of the human family and the scenes of its infancy.

Others will direct our thoughts in other directions, but the farther we proceed the more clearly shall we realize the connection and inter-dependence of all departments of science. Year after year, as meetings of this Association take place, we may also foresee that 'many shall run to and fro and knowledge shall be increased.' Year after year advances will be made in science and in reading that Book of Nature that lies ever open before our eyes ; successive stones will be brought for building up that Temple of Knowledge of which our fathers and we have labored to lay the foundations. May we not well exclaim with old Robert Recorde?—

"Oh woorthy temple of Goddes magnificence : Oh throne of glorye and seate of the lorde : thy substance most pure what tonge can describe? thy signes are so wonderous, surmountinge mannes witte, the effects of thy motions so diuers in kinde: so harde for to searche, and worse for to fynde—Thy woorkes are all wondrous, thy cunning unknowen : yet seedes of all knowledge in that booke are sowen—And yet in that boke who rightly can reade, to all secrete knowledge it will him straighte leade."*

AMERICAN ASSOCIATION FOR ADVANCEMENT OF SCIENCE: FORTY-SIXTH MEETING, DETROIT, AUGUST 7–13, 1897.

The second Detroit meeting of the American Association for the Advancement of Science began on Saturday, August 7, 1897, with a slimly attended meeting of the Council at the Hotel Cadillac. As last year, the first general session was held Monday morning, and the last on Friday evening. The general sessions and all meetings of sections were held in the new Central High School building, which is excellently adapted for the purpose. Superintendent Bliss and the school authorities made every effort to assist the Association.

Monday evening a reception to the Association was given at the High School by the local committee. Thursday afternoon Section G, together with the officers and guests of the Association, were invited to a garden party by Mr. Joseph Berry, of Grosse Pointe. Friday evening there was a reception at the High School building after the final session, and Saturday, August 14th, was given to an excursion to the Ste Claire flats.

The arrangements and management of the local committee were excellent in every respect, and the Detroit meeting, which it was feared would be a failure, was a very successful one. On account of the meeting of the British Association at Toronto, the attendance at Detroit was small, the total registration being only 291. There were present a number of foreign guests, among them being Messrs. A. G. Greenhill, W. E. Hoyle, A. W. Scott, J. Thorp, D. H. Mar-

*Preface to Robert Recorde's *Castle of Knowledge*, 1556.

shall, W. Doberck, R. Munro, R. Gowing, A. B. Macallum, A. G. Vernon-Harcourt, W. Duddell, J. L. Myres, A. Penck, E. B. Poulton and Prince Krapotkin. There were elected 126 new members, and 50 members were made fellows.

On account of the death of retiring President Cope, the Monday morning session was opened by Dr. Theodore Gill, the senior Vice-President of the Buffalo meeting. He introduced W J McGee, acting President of the Detroit meeting and serving in the place of Dr. Wolcott Gibbs, who was ill and was forbidden by his physician to be present. The vacancies in the chairmanships of Sections F and E, Zoology and Geology, caused by the decease of G. Browne Goode and the absence of Professor White, were filled by the selection of L. O. Howard and E. W. Claypole.

Besides the morning meetings, the Council held three long evening sessions. It was urged very strongly that the methods of business procedure of the Association needed to be simplified, and as the first step in this direction certain amendments proposed before the general session in 1896 were recommended for passage by the Association and after presentation to it were passed. These amendments leave the selection of officers and the fixing of the place of meeting wholly in the hands of the Nominating Committee. Also, the power of Council was somewhat extended, the plan being to give it still further powers.

Section H, Anthropology, was granted permission by the Council to hold a winter meeting.

Messrs. Colburn, Morse, Prescott, Woodward and Howard were appointed a committee to secure uniform nomenclature in scientific terms used in commerce. A report prepared by Mr. Colburn was accepted by the committee, and the Council ordered the report to be printed by the Permanent Secretary.

The movement to raise funds for a statue of Gallileo Ferraris was recommended to the favorable consideration of the Association.

The action taken at the Buffalo meeting, whereby the annual volume was considerably abridged, was repealed.

A grant of $100 from the research fund was made to the marine biological laboratory at Woods Holl, the committee on the laboratory for 1898 to consist of the outgoing and incoming Vice-Presidents of Sections F and G, together with the director of the laboratory.

The following were appointed a committee on extending the influence of the Association into the secondary schools: E. S. Morse, W. Orr, Jr., T. C. Chamberlin.

The special committees of the Association were continued, the personnel of *4*, on the policy of the Association, being changed slightly, so as to consist of the President, Permanent Secretary and Treasurer, *ex-officio*, together with Messrs. L. O. Howard, W. H. Brewer, T. C. Mendenhall and Mansfield Merriman. No report was received from *6*, on standard colors and standard nomenclature of colors, but it was understood that much work had been done by the committee.

On Friday morning, in general session, the resignation of Permanent Secretary Putnam was announced. Also, the selection of Boston as the place of meeting for 1898, the jubilee year of the Association. Also, the choice of the following officers for 1898:

President—F. W. Putnam, Cambridge, Mass.

Permanent Secretary—L. O. Howard, Washington, D. C.

General Secretary—D. S. Kellicott, Columbus, O.

Council Secretary—F. Bedell, Ithaca, N. Y.

Treasurer—R. S. Woodward, New York.

Vice-Presidents—Mathematics and As-

tronomy, E. E. Barnard, University of Chicago; Physics, Frank P. Whitman, Adelbert College, Cleveland; Chemistry, Edgar F. Smith, University of Pennsylvania; Mechanical Science and Engineering, M. E. Cooley, University of Michigan; Geology and Geography, H. L. Fairchild, Rochester University; Zoology, A. S. Packard, Brown University, Providence, R. I.; Botany, W. F. Farlow, Harvard University; Anthropology, J. McKeen Cattell, Columbia University; Economic Science and Statistics, Archibald Blue, Director of Bureau of Mines, Toronto, Canada.

Secretaries of the Sections—Mathematics and Astronomy, Alexander Ziwet, University of Michigan; Physics, E. B. Ross, Wesleyan University; Chemistry, Charles Baskerville, University of North Carolina; Mechanical Science and Engineering, Wm. S. Aldrich, University of West Virginia; Geology and Geography, Warren Upham, St. Paul, Minn; Zoology, C. W. Stiles, Department of Agriculture, Washington, D. C.; Botany, Erwin F. Smith, Department of Agriculture, Washington, D. C.; Anthropology, M. H. Saville, American Museum of Natural History, New York City; Economic Science and Statistics, Marcus Benjamin, U. S. National Museum, Washington, D. C.

On Friday evening there was a general session at which the usual complimentary resolutions were passed, after which the 46th meeting of the Association was declared adjourned. As has been said, this was an unusually good meeting. The scientific papers were above the average, and the sections were well attended by citizens of Detroit as well as by members. A number of the distinguished foreign guests gave papers and took part in the discussions.

During the Association week meetings were held by the American Chemistry Society, the Society for the Promotion of Agricultural Science, the Society of Economic Entomologists and the Michigan Academy of Sciences. Some of these meetings were held jointly with sections of the American Association. It is believed that by offering proper courtesies to the affiliated societies more of these joint meetings can be held, to the great advantage of the Association and of the societies themselves.

ASAPH HALL, JR.,
General Secretary.

CURRENT NOTES ON PHYSIOGRAPHY.

THE ATHABASCA REGION.

TYRRELL'S report on the country between Athabasca lake and Churchill river (Geol. Surv. Canada, Ann. Rep., VIII., for 1895–1897) divides the region into Archæan and Cambrian areas. The first is occupied by low rocky hills and ridges from fifty to a hundred and fifty feet in local relief, separated by drift-covered depressions, wooded or interrupted by small irregular lakes. The second is a monotonous district of horizontal sandstones, forming a sterile plain, thinly wooded, with few lakes. The absence of deep valleys and the occurrence of lakes and rapids shows that the drainage is very new. It is suggested that Athabaska lake occupies a pre-glacial valley, excavated along the northern boundary of the sandstone area, when the land thereabouts stood higher or sloped more to the west. Till is scanty on the Archæan area, but more plentiful on the sandstone plain. Rugged moraines are found further southwest, like Duck and Riding mountains, in Manitoba. The most interesting drift hills of the region are steep, narrow ridges, half a mile or more in length, averaging 120 feet in height, standing parallel to the line of glacial motion and rounding down gently at both ends. Unlike drumlins, they consist of unassorted rock flour mixed with boulders, and they all lie on the floors of large post-glacial lakes, now drained. They are explained as deposits in quiet water occupying ice gorges, and Tyrell calls them

'ispatinows,' the Cree work for a conspicuous hill. They seem to be similar to the 'paha' described by McGee in Iowa. The prefix 'Hyper' is used with the name of existing lakes, to indicate their glacial expansion to greater height and area.

SENECA COUNTY, N. Y.

THE Annual Report of the State Geologist of New York for 1894 (lately received) contains an account of Seneca county by D. F. Lincoln. The northern part of the county includes a part of the Ontario plain, varied chiefly by long narrow drumlins. Southward from the plain a gradual ascent is made to the upland, here dissected by the deep sub-parallel troughs of Cayuga and Seneca lakes. Near the southern border, great flat hills rise several hundred feet above the upland, these being outliers of Portage strata from the higher Allegheny plateau further south. The slope from the upland into the lake troughs is notably smooth, being furrowed only by post-glacial ravines in which cliffs and falls are picturesquely developed; but in pre-glacial time the slopes must have been more furrowed, inasmuch as several side valleys now appear to be obliterated by drift filling.

DRAINAGE MAP OF RHODE ISLAND.

THE 18th Annual Report of the Rhode Island Board of Health contains a contour map of the drainage areas on a scale of four miles to an inch, based on the topographical State map and prepared by D. W. Hoyt. The terminal moraine near the south coast forms a divide by which the Pawcatuck and its tributaries from among the hills are turned westward, instead of flowing directly to the ocean. It is noted that Moshassuck valley, west of Providence, was probably the pre-glacial course of the Blackstone, which now flows east of the city into the head of Narragansett bay. The present course of the river is interrupted by ledges, furnishing water power that is actively employed at Valley Falls and Pawtucket; the inferred pre-glacial course is obstructed by drift, in which driven wells are supplied with water from a 'subterranean Blackstone.'

POPOCATAPETL AND IXTACCIHUATL.

A SERIES of interesting and well illustrated observations on the two great Mexican mountains, by O. C. Farrington, forms publication 18 of the Field Columbian Museum, of Chicago (Geol. Series, Vol. I., No. 2). The upper cone of Popocatapetl, clothed with sand and snow, has a nearly uniform slope; the middle portion is carved by numerous channels; "the lower portion is involved in the tortuous folds which make up the Sierra." The summit crater is a pit, 2,000 feet in greater diameter, 1,300 feet in lesser diameter, and from 800 to 1,500 feet deep, from whose walls of discordant lava beds and breccia rocks continually fall to the bottom. The cumulus clouds that frequently envelop the mountain flank in the afternoon are (erroneously?) ascribed to cooling caused by snow. Ixtaccihuatl is described as of more massive and uniform structure, and without distinct crater, as if the product of fissure erruption; but as mention is made of lava beds on its flanks, weathered to deep soil near the base and dissected into ragged spurs on the slopes, it seems possible that long continued erosion may be the chief cause of its unlikeness to volcanoes of more ordinary form. The snow reservoirs near the summits suggest the same conclusion.

WADIS OF TRIPOLI.

FURTHER notes on the Tripoli hill range, by H. S. Cowper (London Geogr. Journ., IX., 1897, 620–638), contain, among other items, a number of illustrations and brief descriptions of the wadis that descend toward the Mediterranean coast. They dissect the hill country, emerging by gate-

like outlets in its north-facing escarpment, and then traverse a sloping plain that descends to a barren sandy strip before reaching the sea. They form the natural paths of travel by which the hill tribesmen always go to and from the coast.

W. M. Davis.

Harvard University.

CURRENT NOTES ON ANTHROPOLOGY.

STUDIES IN MAYAN HIEROGLYPHS.

It is as agreeable as it is rare to find a sane student of the Mayan hieroglyphs. For that reason among others it is pleasurable to mention several articles which have appeared lately from the pen of Mr. Lewis W. Gunckel, of Dayton, Ohio.

Two of these are in the *American Antiquarian* for the present year. They are entitled, 'The numeral signs in the Palenque tablets,' and 'An Analysis of the day-signs in the Palenquen inscriptions.' A third is in the *American Anthropologist* for May on, 'The direction in which Mayan inscriptions should be read.' All of these indicate thorough investigation and calm judgment, as well as a good acquaintance with what his predecessors in the field have accomplished. The method pursued is scientific and the presentation of the results temperate.

Of course, some of such results may have to be modified by future research, and they may not be good in all cases, that is, in other parts of the field; but the plan which Mr. Gunckel has adopted of approaching these intricate problems is one sure to be productive of additions to our positive knowledge concerning them.

PRIMITIVE DECORATIVE ART.

For the analysis of primitive art-motives no paper has appeared for a long while more instructive than that by Dr. Franz Boas in the Bulletin of the American Museum of Natural History, Vol. IX., entitled 'The decorative art of the Indians of the North Pacific Coast.' The tribes whom he has in view are celebrated for the abundance of their painting and sculpture, their totem poles, colored dishes and carved pipes, and all are somewhat familiar with their strange and perplexing designs. These are analyzed in the article referred to with masterly skill, and the text is furnished with ample and accurate illustrations, which enable the reader to follow the demonstration step by step.

Certain general principles furnish the key to these primitive art-motives. It was the aim of the artist to bring into prominence the most specific feature of the animal he drew, and yet to show as much of the whole of it as he could. As he knew nothing of perspective, he resorted to the most curious devices to accomplish his aim. He represented his subject in sections and distortions, and sometimes by its specific feature reduced to a mere symbol, as a beaver by its incisor teeth only. Many of these devices belong to primitive art generally, and hence this paper will efficiently aid the student in other fields than the Northwest Coast.

D. G. Brinton.

University of Pennsylvania.

SCIENTIFIC NOTES AND NEWS.

We publish elsewhere a full report, by the General Secretary, of the Detroit meeting of the American Association for the Advancement of Science. Although the attendance was small, the scientific programs were in many sections unusually strong and promise well for the future of the Association. A notable meeting on the occasion of the fiftieth anniversary of the Association next year at Boston, with Professor Putnam as President and Mr. Howard as Permanent Secretary, is assured.

We are glad to be able to publish in this issue the address of the President of the British Association, given on Wednesday of this week. The addresses of the Presidents of the Sections

were of great interest. These were in most cases on general topics, and in accordance with the custom of the Association a special title was not given to most of the addresses and the subjects were withheld until they were delivered. The programs promise the discussion of many interesting topics, American men of science being well represented.

THE French journals publish the programs for the meeting of the French Association for the Advancement of Science, held last week at Saint-Étienne. There were fifteen papers presented in mathematics, fifteen in the physical and chemical sciences, seventy-two in the natural sciences and twenty-eight in the economic sciences. Many interesting topics were brought forward, but, contrary to the usual programs of the British Association, there is a noticeable absence of the names of French men of science having an international reputation. The Association appears, however, to be in a flourishing condition as regards number of members and finances, the annual receipts amounting to nearly $20,000.

THE British Treasury has appointed a committee "to consider and report upon the desirability of establishing a National Physical Laboratory for the testing and verification of instruments for physical investigation, for the construction and preservation of standards of measurement, and for the systematic determination of physical constants and numerical *data* useful for scientific and industrial purposes, and to report whether the work of such an institution, if established, could be associated with any testing or standardizing work already performed wholly or partly at the public cost." The members of the committee are: Lord Rayleigh (chairman), Sir Courtenay Boyle, Sir Andrew Noble, Sir John Wolfe Barry, W. C. Roberts-Austen, Esq., Robert Chalmers, Esq., A. W. Rücker, Esq., Alexander Siemens, Esq., and T. E. Thorpe, Esq.

THE bill regarding the use of the metric system in Great Britain has been passed by the House of Lords.

THE American Museum of Natural History, New York, has been presented with two fine collections of butterflies. Mr. William Shaus, formerly of New York, but now resident in London, has given his collection of tropical butterflies, said to contain over 10,000 specimens and valued at $20,000. Dean E. A. Hoffman, of the General Theological Seminary, New York, is the other donor, and his collection is said to be complete with regard to North American species.

THE Arnold Aboretum, Harvard University, has received from Miss Abbey A. Bradley, of Hingham, Mass., a gift of $20,000. The money has been given in memory of her father, the late William L. Bradley, the income to be used in scientific investigations on arboriculture.

THE British House of Commons has voted £809,992 for the Department of Science and Art and £162,439 for the British Museum.

M. FALGUIÈRE has now completed his model for the statue of Pasteur. It is expected that the Municipal Council will permit the erection of the statue on the space between the Panthéon and l'Odéon.

DR. JOSEPH J. KINYOUN, of the U. S. Marine Hospital Service, has been designated by the Secretary of the Treasury as a delegate to the International Conference on Leprosy, to be held at Berlin during October, and has also been directed to visit the Continental bacteriological laboratories for the information of the Marine Hospital Service.

MR. T. I. POCKOCK has been appointed Assistant Geologist in the British Geological Survey. Dr. W. F. Hume and Mr. L. Gorringe have been appointed assistants of the Geological Survey of Egypt, the work of which, as we announced last week, has been greatly enlarged.

THE Brooklyn Institute announces that Dr. Fridjof Nansen is one of the lecturers engaged for the coming season.

THE Royal College of Physicians, London, has conferred the Moxon gold medal on Sir Samuel Wilks, President of the College, for his work in clinical medicine, and the Baly medal on Professor Schäfer, for his work in physiology.

THE Civil Service Commission announce a vacancy in the position of computor in the

office of the Coast and Geodetic Survey, and several vacancies in the position of fish culturist. Details can be obtained by application to the Commission.

Professor Langley was present at the meeting of the Paris Academy of Sciences on August 2d, and was welcomed by the President and M. Berthelot. Professor Langley gave an account of the results of his experiments with the aërodrome.

Lord Kelvin arrived in New York last Friday on the 'Campania.' He will return to New York on his way home after the meeting of the British Association and a visit to Nova Scotia.

The second International Bibliographical Conference opened its proceedings, under the presidency of M. le Chevalier Descamps David and M. Lafontaine, at Brussels on August 2d. At the opening session the delegates gave an account of bibliographical progress in their respective countries.

The conference of South African States on the rinderpest was opened at Pretoria on August 2d, with Mr. Schutte as chairman. Rinderpest is reported to have destroyed the buffalo in North Matabeleland. The natives state that since the disappearance of the buffalo the tsetse fly has been unknown in the fly belt.

The British Institute of Mechanical Engineers celebrated, beginning on July 29th, the fiftieth anniversary of its foundation. The meeting was at Birmingham, where the Institute was founded and where it had its headquarters until 1877, when it was removed to London. The President, Mr. E. Windsor Richards, gave an account of the history of the Institute, with special reference to the presidents, beginning with George Stevenson. A gift of £3,000 was voted to the retiring Secretary, Mr. Bache, in recognition of his services which have contributed so greatly to the success of the Institute.

The Third International Congress of Sociology met at the Sorbonne, Paris, during the last week in July, under the presidency of M. Paul de Lilienfeld, Senator of the Russian Empire.

We learn from the *Revue Scientifique* that M. Louis Adrien Levat, President of the *Ligue Française ornithophile*, having its headquarters in Aix-en-Provençe, is engaged in organizing an international congress for the protection of insectiverous birds. It is proposed to hold the congress in October next and foreign societies are invited to send delegates.

The Sixteenth Congress of the Sanitary Institute of Great Britain will be held at Leeds from the 14th to the 18th of September, under the presidency of Dr. Robert Farquharson, M. P. An exhibition will be held in connection with the Congress.

The commissioners for the Exhibition of 1851 have made appointments to Science Research Scholarships for the year 1897, on the recommendation of the authorities of the respective universities and colleges. The scholarships are of the value of £150 a year, and are ordinarily tenable for two years in any university at home or abroad. The scholars are to devote themselves exclusively to study and research in some branch of science, the extension of which is important to the industries of the country. A limited number of the scholarships are renewed for a third year where it appears that the renewal is likely to result directly in work of scientific importance. This year three scholars have been reappointed for a third term, fourteen have been reappointed for a second term, and nineteen new appointments have been made. The Scholarships Committee consisted of Sir Henry Roscoe, chairman, Lord Rayleigh, Lord Kelvin, Lord Playfair, the late Mr. Mundella, Dr. William Garnett and Sir J. Norman Lockyer.

The John Lucas Walker studentship of pathology at Cambridge is vacant and candidates are invited to send applications to Dr. A. A. Kanthack, Cambridge, not later than October 15th. The scholarship is for original research in pathology and is of the annual value of £250, tenable for three years. It is open to women as well as men.

It is well known that before the success of the Atlantic Cable a company was formed to establish communication with Europe by an overland telegraph line via Alaska and Siberia,

and surveys in Alaska were made for this purpose. Mr. R. A. Fessenden contributes an article to the *Electrical World* raising the question of reviving the plan for such a telegraph line. He maintains that commerce with the East would justify the cost and that high speed systems of telegraphy would give it a great advantage over sub-marine cables even in communication between America and Europe.

THE Appalachian Mountain Club of Boston, has arranged an excursion to the Isle of Shoals, N. H., leaving Boston by special car at 9:40 a. m. on September 4th, returning on September 7th.

IT is reported that the biological expedition of Columbia University returning from Alaska lost its specimens and instruments in the wreck of the steamship *Mexico*. It was also reported that the anthropological expedition of the Field Columbia Museum had lost the extensive collections secured in Alaska, but this appears to be incorrect.

IT is stated in the *Scientific American* that Mr. H. P. Flower, Mayor of New Orleans, has just returned from Paris, where he went in order to study the Bertillon system for the identification of criminals. The system will be adopted in New Orleans, and will be taught to the police captains by Mr. Flower.

WE recorded last spring the sale of a great auk's egg for £294. Though the subiect has, perhaps, no greater scientific interest than that of the sale of a rare postage stamp, it may be noticed that another of the eggs, slightly cracked, has been sold in London for £168. The purchaser, Mr. Middlebrook, has now three specimens in his collection.

THE recent French motor-car race from Paris to Dieppe showed an advance, in that the carriages were not entered by the makers, but by the owners. Fifty-nine carriages started, the winner traversing the distance of ninety-three and three-fourths miles in scarcely more than four hours. There was only one steam-carriage and none with electrical motor, oil being used in fifty-eight of the fifty-nine carriages.

THE issue of the *Scientific American* for August 7th very properly criticises another journal for publishing a story about an English lady who lost her diamond ring in the dough of a cake and found it by means of X-rays, remarking that "this very improbable story doubtless originated in the brain of some reporter." It happens, however, that a few pages further on in the same issue the *Scientific American* publishes a long article translated from a French illustrated journal on the X-rays in the custom house. The article contains elaborate illustrations of the radioscopic examination of a valise, of the detection of a smuggler, etc. The facts of the matter are that M. Pallin, the Director of Customs, has considered the possibility of using X-rays in certain special cases, but the detailed accounts and the alleged photographs of the article evidently 'originated in the brain of some reporter.'

JACOB NORTH & Company, Lincoln, Neb., announce that they have in press the Phytogeography of Nebraska, by Dr. Roscoe Pound, Director of the Biological Survey of Nebraska, and Mr. F. E. Clements, assistant instructor in botany in the University of Nebraska. It is the first volume of a series intended to present in a number of volumes the results of the investigation of the floral covering of Nebraska, which has been in progress for the past five years in the Botanical Survey of that State. The volume deals primarily with phytogeographical problems in Nebraska, but gives a general treatment of the phytogeographical principles relating to distributional statistics, regional limitation, vegetation forms, habitat groups, plant formations, etc.

A CIRCULAR has been issued announcing a journal entitled *Intermédiare des biologistes*, intended to be an international organ for zoology, botany, physiology and psychology. The journal will be edited by M. Alfred Binet, the well-known French psychologist, with the help of two of his psychological assistants, MM. Victor Henri and N. Vaschide, and will be published on the 5th and 20th of each month by Schleicher Frères, Paris. The date when the publication will begin and the price are not given. The journal proposes to cover six departments : A bulletin of notes and news, questions and answers, abstracts, preliminary notices, one short original article and new apparatus.

THE *Zeitschrift für Psychologie und Physiologie der Sinnesorgane*, edited by Professors H. Ebbinghaus and Arthur König, and published since its foundation by Leopold Voss, Hamburg, will hereafter be published by J. A. Barth, Leipzig. The same publisher will also assume the publication of the continuation of Professor J. von Kries' 'Abhandlungen zur Physiologie der Gesichtsempfindungen' and of Helmholtz's 'Vorlesungen über Theoretische Physik,' of which latter work they hope to publish two further volumes during the coming year.

WE are glad to note the establishment of a monthly scientific journal at DeLand, Fla., entitled *Studies from Nature*. Although the subscription price is only 50 cents per annum, we fear that the publishers will not succeed in securing the 50,000 subscribers that they expect. Such local journals devoted to the natural sciences as they appeal to amateurs are healthful signs of an interest in what the conductors of this journal call 'The Wonders and Beauties of Nature.'

DR. W. FLINDERS PETRIE, the Egyptologist, has sent, according to the daily papers, to Dr. Breasod, of the University of Chicago, a valuable collection of relics excavated along the Nile. Among these are statues of Nen Khefea, a wealthy nobleman, and his wife, which are said to be nearly 5,000 years old. They are of limestone and are remarkably well preserved. They will go to the Haskell Oriental Museum of the University.

WE learn from *Natural Science* that the Zoological Museum of the Royal Academy of Science, St. Petersburg, has acquired thirty-three specimens of fossil bones and numerous remains of Post-Tertiary mammals collected by J. Savenkov at Krasnoyarsk. Among them are some bones and a piece of skin of *Rhinoceros tichorhinus*, which were taken from a well-preserved specimen of a rhinoceros, covered with skin, found 60 versts east of Kasatschje, on the bank of the Charaula, a left tributary of the Tomskaia. Dr. G. Stefanescu, the eminent Roumanian geologist, has discovered two portions of the mandible of a species of *Camelus* in an undoubted Quaternary gravel, six meters below the surface on the river bank of the Olt at Milcovul-de-jos, near Slatina, Roumania. He regards the species to which they belong as new, and names it *Camelus alutensis*.

WE learn from *Nature* that at a meeting of the Essex Field Club, on July 21st, a discussion was held for the consideration of practical methods for the protection of our native fauna and flora from the destruction and actual extermination which now threaten many interesting species. Mr. C. G. Barrett (Hon. Secretary to the Committee of the Entomological Society for the Protection of Insects in danger of extermination) opened the subject by a short address on 'Insect protection; its necessity, means and objects.' Mr. J. E. Harting spoke with respect to birds and mammals; Professor Boulger referred to the wholesale collecting which was exterminating many rare plants; and Professor Meldola urged that children should be taught to respect the sacredness of life. The following resolution of Professor Boulger's was adopted unanimously, and the Club resolved to assist the scheme of the Entomological Society in every possible way: "That in view of the danger of extermination threatening many beautiful, rare and interesting plants, all lovers of nature should do their best to avoid this danger: (*a*) By abstaining from wholesale collecting, collecting for merely individual private collections, needless rooting-up of specimens, attempting to cultivate wild specimens of refractory species, and purchasing such wild specimens from itinerant or other dealers; (*b*) by endeavoring to persuade others, especially school children, cottage gardeners, and dwellers in large towns, to a similar abstention."

A REUTER telegram from Stockholm says that in a letter to the *Aftonblad*, Dr. Nils Ekholm, who accompanied Herr Andrée to Spitzbergen last year with the intention of taking part in his aërial voyage, offers some remarks on the prospect of the expedition based on the full details now received of Herr Andrée's ascent. Herr Ekholm declined to go this year because he considered that the impermeability of the balloon was unsatisfactory. In his letter he points out that from the day the balloon was fully inflated it lost 51 cubic meters of gas every 24 hours, representing a diminution in

carrying capacity of 56 kilogrammes per day. This, he says, shows that the imperviousness of the balloon had not been essentially increased since last year. Besides this daily escape, various circumstances led to a certain loss of gas in the ascent itself, necessitating a corresponding sacrifice of ballast. After making allowance for these losses of gas, and taking into consideration the fact that in the ascent part of the drag-ropes were lost and that the balloon at once rose to a height of 15,000 ft. to 25,000 ft., which was more than had been reckoned upon, Dr. Ekholm comes to the following conclusions: The longest time for which the balloon would remain in the air would be from 22 to 24 days, and less if mountains exceeding the height attained at the start had to be crossed. As the duration of the projected voyage may be estimated in ordinary conditions as regards wind at 24 days, remarkable good fortune would be necessary for success.

LIEUTENANTS VANNUTELLI AND CATERNI, the surviving officers of the Bottego expedition, have sent in a report to the Italian Geographical Society, which is summarized in a dispatch to the London *Times*. The expedition set out on February 2, 1895, from Sancurar, and after touching Vollamo visited Pogadesen (?), and arrived on June 1, 1896, at Omo. In consequence of continuous fighting with the warlike tribes inhabiting these regions, the members of the expedition were obliged to spend the months of July and August, 1896, on the shores of Lake Rudolf. At this point Dr. Sacchi left the expedition, taking with him some valuable mineralogical and zoological collections and proceeded to Lugh. The main expedition proceeded up to the Ethiopian plateau, stopping at Sajo, whence a letter was forwarded to the Galla chief Degiasmac. In consequence of the friendly assurances given by the latter, the expedition continued its forward march, arriving on March 16th of the present year in the neighborhood of Gabo. The chief, notwithstanding his friendly assurances, behaved treacherously and caused the party to be surrounded, so that they had no course left but to attempt to cut their way out. Of the 86 members of the expedition, 66, including its leader, were killed, the survivors being taken prisoners and having many hardships to endure. On June 6th last the captives were sent by order of the Emperor Menelik to Shoa, where they arrived on June 22d and were handed over to Major Nerazzini. The documents belonging to the expedition were saved, only the collections intrusted to Dr. Sacchi having been lost. It is thought probable that the latter was killed.

THE British Society of Inspectors of Weights and Measures recently held its annual general meeting in London. The total membership of the Society is now upwards of three hundred, and sixty cities and towns were represented at the meeting. Sir Henry Roscoe, the Vice-President, made an address on the subject of the metric system of weights and measures. He reminded the members that he was the Chairman of the Select Committee of the House of Commons, appointed two sessions ago, to report on the question of how far it was desirable to alter our system of weights and measures and adopt the metric system, which, he said, was almost universal throughout civilized, and to some extent uncivilized countries. He joined with the members of the Society in the hope that the bill would soon pass into law. It did not do all that they had hoped for, but they must, he thought, accept it as an installment. Sir John Hutton reported that of one and three-quarter million scales examined in London, one-third had proved defective. The members of the Society visited the Victorian Exhibition of the Crystal Palace, where a Section of Weights and Measures had been organized by the Society, and subsequently went to Paris to view the standards and appliances of the French government at the Bureau central.

THE Berlin Town Council has decided to appoint a municipal 'hydrologist' for the hygienic supervision of the water supply of the city.

SIGNOR CESARESCO writes to the London *Times* asking for the suppression of the export of quails and small birds from Italy to England. It is said that millions are sent to England from Egypt and from the south of Italy, part of which are caught in defiance of such protective laws as exist, while the rest are netted in the spring and autumn and are kept in more or less

misery till the time comes for their despatch to meet the requirements of the London season, which coincides with the natural nesting time. The French government for some years prohibited the transit of quails through France in the close season, but as this simply led to their being sent through Germany and Belgium the prohibition has been removed, notwithstanding the protests of the Union des Sociétés des Chasses. Millions of small birds called 'larks,' though they include every variety, and especially robbins, killed largely during the breeding season, are also annually exported to England, and it is feared that they will be entirely exterminated in Italy.

UNIVERSITY AND EDUCATIONAL NEWS.

A LARGE majority of the professors of Brown University have signed an open letter addressing to the corporation a protest against attempting to curtail the freedom of speech of the President. The letter gives a straightforward expression to the views which university professors should unite in maintaining and removes from Brown University the stigma put by the corporation in claiming that they can control the freedom of speech of its faculty. President Andrews, however, in accepting the presidency of a magazine 'university' confuses the friends of academic freedom.

THE London University Commission bill has been postponed by the government until next year.

IT is reported in the daily papers that Mr. Washington Corrington, of Peoria, Ill., now eighty-five years old, has appointed trustees to have control of his property, to be used after his death to found a university at Peoria. His property is estimated at over $1,000,000.

THE Bradley Polytechnic Institute, of Peoria, will be dedicated on October 8th, the principal address being made by the Secretary of the Treasury, Hon. Lyman J. Gage.

THE trustees of the University of Illinois have decided to admit women to the College of Physicians, Chicago.

AT a recent meeting of the Council of the University of Paris it was resolved that, as soon as financial resources permitted, the following courses should be added: Experimental physiology, objective psychology and astronomical physics, and additional courses in paleontology and histology.

IT is intended that the name of Croom Robertson, late Grote professor in University College, London, to whom psychology in England is greatly indebted, shall be connected in some way with the new psychological laboratory established at University College. The principal contributors to the fund are Mr. Haldane, Q. C., Mr. A. J. Balfour, Professor H. Sidgwick, Mr. F. Galton, Dr. Savage, Sir John Lubbock and Mr. Shadworth Hodgson.

THE London *Times* reports that at Dewsbury, after the funeral of Dr. Hinchliffe, it was announced that the deceased, after providing for his housekeeper and servants, had bequeathed property and shares, with about £50,000, toward higher education, but the purposes of the bequest are not stated.

DR. H. V. NEAL, Harvard University, has been elected professor of biology at Knox College, Galesburg, Ill.

M. IZOULET has been appointed to the newly established professorship of social philosophy in the Collège de France.

MR. W. W. WATTS, Assistant Geologist at the British Geological Survey, has been appointed assistant professor of geology at Mason College, Birmingham.

DR. HERMANN THOMES, docent in pharmaceutical chemistry in the University of Berlin, has been promoted to a professorship. Professor George Ruge, of Amsterdam, has been appointed professor of anatomy and director of the Anatomical Institute at Zurich. Dr. Ossan, associate professor of mineralogy at Heidelberg, has been called to a chair in the School of Chemistry at Mühlhausen.

DISCUSSION AND CORRESPONDENCE.

THE ANTECEDENT COLORADO.

TO THE EDITOR OF SCIENCE: In addition to the doubts brought forward by Davis (SCIENCE,

April 23, 1897) and Emmons (SCIENCE, July 2d), as to the antecedent origin of the Green river in its passage through the Uinta mountains, I would suggest an independent and confirmatory argument for the consequent origin of the Green-Colorado in its passage across the plateaus of the Grand Canyon region, where it has been regarded as antecedent by Powell and Dutton. My argument is based on the curvature of the river and especially on its meanders. The meanders are surprising in themselves from the steepness of the river and their deep incision; yet more surprising is the location of strong meander reaches just up stream from structural displacements. It is the latter relation that I wish to point out.

In general, a river meanders when its declivity is low. The Mississippi below Memphis falls less than five inches to the mile and has a typical meandering course (See Table of Meanders). Yet the Colorado, falling more than seven feet per mile in the Canyon region, has stretches of even greater sinuosity and the distribution of these winding reaches suggests that the river is not antecedent, but dependent on the dislocations for its path.

The following table shows the rate of meander for measured stretches of the river, the rate being expressed in miles of actual stream to 100 miles along a mean course traced evenly through the meanders, without departing more than a mile from the water at any point. In the first column is the name given by Powell to the stretches of river, in the second the miles of mean course, in the third the actual course, while the fourth contains the rate of meander:

1	2	3	4
Desolation and Gray Canyons—Uinta R. to Book Cliffs, ...	76	113	149
Gunnison's Valley—to San Rafael R	30	35	117
Labyrinth Canyon—to Grand R . .	51	93	182
Cataract Canyon — to N 37°37′, W 110°38′.	77	81	105
Glen Canyon and above—to Paria R	88	139	158
Marble and Grand Canyons — to Grand Wash	259½	280	108
Thence to California boundary. . .	139	145	104
Mississippi — Memphis to Baton Rouge			155

The 139 miles of strong meander above the Paria River bring the Colorado down to the East Kaibab monocline, where the course turns to the south to avoid the uplifted Kaibab plateau, just as the Green turns east on reaching the Uintas. This is best seen on the United States Relief Map, where the darker color is within the river's elbow at the Uinta and against the Kaibab.

At the monocline the river is deviated. In Glen Canyon above the monocline the meandering is greater than the Mississippi's. Below the meandering is reduced to a minimum.

The conclusion is irresistible that the Kaibab uplift introduced a local baselevel (Powell's phrase) that compelled the river to meander on a flat open course until the obstacle gave passage to one side.

Less than a hundred miles further north in the Cataract Canyon, near the junction of the Green and Grand, the river's course is straight (meander rate, 105). Next above this is the very sinuous Labyrinth Canyon (rate, 182). The geological map here shows a dome with Permian and Carboniferous brought to the surface, a part probably of the San Rafael disturbance. Through the dome the course is in the straight Cataract Canyon; the Labyrinth Canyon is the northern approach.

Is the analogy here to the Kaibab and Glen Canyon casual?

Gunnison's valley is instructive. It has little meander and no uplift. Dutton reports it to be the only open valley on the river besides Brown's Park, and attributes this character to the softness of strata that weather back too rapidly to stand in canyon walls. In this case surface meanders would be lost here, as the the valley would straighten as it widened under erosion.

To the north the meandering is again great. At the time the river took to meandering it may well have had such a course from the Uintas to the dome, preserved to us where the rocks were hard and the river now runs in canyons, but lost in the softer strata. North of the Uintas I have no map, but this stretch of Gunnison's suggests that meanders would not be preserved in the soft rocks of the Bad Lands.

In this connection I would call attention to a striking feature of the Grand Canyon faults, as described by Dutton in his monograph. He says the ends of the down-thrown strata are commonly turned *down* in this region, the beds on the other side coming undisturbed to the fault. This is specifically described for the West Kaibab and Hurricane faults, both with up-throw to east.

The phenomenon of the down-turned edges is puzzling, but it might result from the following history. All the steps assumed to follow in succession are found in the region to-day:

1. Western beds flexed up, giving a western high level passing through a monocline to an eastern low level.

2. Flexure becomes a fault at the foot (east end) of the monocline, giving western high level passing down a monocline to an east-facing fault cliff, below which lie the horizontal beds of the undisturbed side.

3. Reversal of fault, giving upthrow on east and the structure existing to-day—low level on west passing to a west-facing fault cliff by a down-turn (monocline perhaps partly obliterated by friction during the reversal).

In confirmation is the fact that both faults are greatest in the north and steadily diminish southward, the Hurricane having at the river less than a sixth of its northern value, while the West Kaibab disappears just where it crosses the chasm. Dutton thinks it reappears to the south of the canyon, but *reversed*, giving an east-facing cliff. So if the observation of Dutton is good, reversal of fault has occurred in one case and there is a suggestion of it in the other. Now the significance of this fault history is that the river seems conscious of something of the sort. It turns south on the second V of the Grand Canyon at the Hurricane fault, as if to avoid the early western uplift, now recorded only in the down-turned strata-ends; while at the Kaibal the reversal-point has been selected by the river to return northward from the deviation about the uplift here. The peculiar grouping of meanders is readily seen on the map, as also the relation of bends in the river to the displacements at the Uinta, junction of Grand and Green, Kaibab (East and West), and Hurricane.

In explaining these latter events as represented in effect on the present river, I have founded my suggestion on that simple and diagrammatic character that Powell and Dutton have described in this region.

Are not these additional grounds for questioning the Colorado's antecedence?

Mark S. W. Jefferson.

Gilmanton, N. H.

AMPHIBIA OR BATRACHIA.

To the Editor of Science: As a teacher of zoology, but without claim to expert authority upon taxonomic points, I read the article of Dr. Baur under the above title (Science, July 30, 1897, 170–174), with the hope and expectation of being able to decide which name to employ hereafter. I regret to confess myself still unconvinced. Dr. Baur shows that the French word *Batraciens* was applied to the frogs, toads and salamanders by Brogniart in 1799, and that the Latin forms *Batrachii* and *Batrachia* were not introduced until 1804 and 1807, by Latreille and Gravenhorst respectively. But does not Dr. Baur lay undue stress upon the distinction between the French and the Latin form. *Batraciens* is not (like *crapaud*, etc.) a vernacular word; it is the French form, or Galloparonym, of the Latin *Batrachia*, and the employment of the former would seem to constructively sanction the use of the latter. In anatomy the employment of either of the national forms, *hippocamp*, *Hippokamp*, *hippocampe*, or *hippocampo*, would be tantamount to the introduction of the international form, *hippocampus*. The principle involved in both cases has been formulated by me in two passages in my 'Neural Terms, International and National (*Jour. Comp. Neurology*, VI., 274, 329), as follows: "The introduction of any derivative, oblique case, or national paronym, practically renders the introducer responsible for the actual or potential Latin antecedent of such words, in accordance with the usual rules of derivation and paronymy." I trust the discussion may continue until all doubts are removed. The case is the more urgent in view of the confusion of students in finding not merely that *Amphibia* and *Batrachia* are synonyms for the entire class,

but also that in Huxley's writings the latter is applied to an ordinal subdivision of the former.

BURT G. WILDER.

SCIENTIFIC LITERATURE.

Report on the Valley Regions of Alabama. By HENRY MCCALLEY, Assistant State Geologist. Part I., on the Tennessee Valley Region, pp. 436. Part II., on the Coosa Valley Regions, pp. 862. Geological Survey of Alabama, Montgomery, 1896–97.

The aim of this report is to give a complete account of the geology and mineral resources of that part of Alabama which is occupied by known Paleozoic formations. This includes approximately the northern third of the State, with an area of about 18,000 square miles. It is limited on the southeast by the metamorphic series of undetermined age and on the southwest by the unconformable post-Paleozoic formations. The term 'valley regions' in the title is somewhat misleading, since all the mountains of Alabama, such as they are, are included in the region described and are as fully treated as the adjacent valleys. Except to one already familiar with the topographic features of the State, the title conveys no idea of location whatever.

The region outlined above is about equally divided between the Tennessee and Coosa drainage basins, and this division is a natural one from geologic and economic points of view. It is, therefore, taken as the basis for subdividing the report into two parts which treat respectively of the Tennessee and Coosa Valley regions. Each part is again subdivided into two sections. In the first is given a general account of the topography, geology and mineral resources, and in the second each county is described in detail. This method of treatment is, perhaps, necessary where the county is the all-important unit in the political and social organization, but its defects are serious as seen in the present case. It involves endless repetition and distributes through a volume details which should be in a compact body. Thus there are 275 more or less extended but entirely distinct references to the limonite deposits, containing sufficient observations for an exhaustive monograph on the subject if brought together and properly arranged. Yet one seeks in vain for any systematic classification of the deposits or a statement of their essential characteristics.

In reading the report one is continually hampered by the lack of maps. It is true the State geological map, published in 1894, is referred to, but its scale is entirely too small for representing details of structure, and in numerous respects it does not correspond with the statements in the report. The crudest sort of sketch maps would be of the greatest assistance to an understanding of the complicated structural relations found in parts of this region. In fact, no amount of verbal description, even from a master of English, can supply their place, and the present case is hopeless for reasons which the following quoted sentence will readily suggest: "The northeast end of the belt, just to the northwest of the Terrapin or Ladiga Mountains, or the portion of that belt within this county, is a portion of the counterpart of the belt last described, or is a portion of the southeast rim of the badly faulted, broad, broken, unsymmetrical synclinal of which the belt last described is the major part of the northwest rim." The reader cannot rid himself of the suspicion that among other reasons for the absence of maps and diagrams is the lack, on the author's part, of a sufficiently clear conception of the structure for their preparation.

In the descriptions of topographic features the principles of modern geography or physiography are entirely ignored. Hence there is a vagueness and uncertainty about the descriptions which might have been excusable twenty years ago, but for which no excuse can be found at the present time. It borders on the absurd to speak of 'high rugged mountains with lofty peaks' in Alabama, where the greatest relief is barely 2,000 feet above the sea-level.

By far the most valuable portion of the report is found in the detailed county descriptions, especially those of mineral deposits. Here is a vast mass of facts, poorly digested and arranged, it is true, but given in such a way that they will be of great service in the economic development of the region. All locations are given by land numbers, so that, while they convey little meaning to the general reader, they are in the best possible form for use by the prospector upon the ground.

C. W. HAYES.

SCIENCE

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AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

*A CHAPTER IN THE HISTORY OF MATHEMATICS.**

ON the 10th of March, 1897, a hundred years after its original presentation, the Royal Academy of Sciences and Letters of Denmark published a French translation of a memoir by Caspar Wessel, entitled *Om Direktionens analytiske Betegning, et Forsög, anvendt fornemmelig til plane og sphaeriske Polygoners Oplösning*, or an Essay on the Analytic Representation of Direction, with Applications in Particular to the Determination of Plane and Spherical Polygons.

This paper, which deals with the geometric representation of imaginary quantities; which was read and printed several years before the famous essay of Argand and contains fully as exact a treatment of the subject, lay buried for nearly a century until attention was again drawn to it in 1895 by a thesis of S. D. Christensen upon the development of mathematics in Denmark and Norway in the eighteenth century.

Inasmuch as this memoir of Wessel's is still comparatively unknown, I have thought that it would not be uninteresting at this time to present a sketch of the development of the geometric treatment of the imaginary, particularly in the latter part of the eighteenth century and the first part of the nineteenth.

We find the square root of a negative quantity appearing for the first time in the *Stereometria* of Heron of Alexandria, 100 B. C. After having given a correct formula for the determination of the volume of a frustum of a pyramid with square base and applied it successfully to the case where the side of

*Address by the Vice-President before Section A, Mathematics and Astronomy.

the lower base is 10, of the upper 2, and the edge 9, the author endeavors to solve the problem when the side of the lower base is 28, of the upper 4, and the edge 15. Instead of the square root of 81–144 required by the formula, he takes the square root of 144–81 and calls it equal to 8 less $\frac{1}{16}$, *i. e.*, he replaces $\sqrt{-1}$ by 1, and fails to observe that the problem as stated is impossible. Whether this mistake was due to Heron or to the ignorance of some copyist cannot be determined.

In the solution of the problem to find a right angled triangle whose perimeter is 12 and area 7, Diophantus, in his *Arithmetica*, 300 A. D., reaches the equation $336x^2+24=172x$ and says that the equation cannot be solved unless the square of the half coefficient of x diminished by the product of 24 and the coefficient of x^2 is a square. No notice is taken of the fact that the value of x in this equation actually involves the square root of a negative quantity.

Bhaskara, born 1114 A. D., in his chapter *Vija Ganita*, was able to go a step further. He gave the rule :

> The square of a positive number as also of a negative number is positive and the square root of a positive number is twofold, positive and negative. There is no square root of a negative number, for this is not a square.

The first mathematician who had the courage actually to use the square root of a negative number in computation was Cardano. At an earlier period he had declared such a quantity to be wholly impossible, but in the *Ars Magna*, 1545, he discusses the problem of dividing 10 into two parts whose product shall be 40 and obtains the values $5+\sqrt{-15}$, $5-\sqrt{-15}$. These he verifies by multiplication. Such quantities he calls sophistic, since it is not permissible to operate with them as with pure negative numbers or others, nor to assign them a meaning.

Bombelli, in his *Algebra*, 1572, gives a number of rules for the use of such quantities as $a+b\sqrt{-1}$, but makes no endeavor to explain their character.

Girard knew that every equation has as many roots as its degree indicates and consequently recognized the existence of imaginary roots. In his *Invention nouvelle en l' algèbre*, 1629, while discussing the roots of the equation $x^4-4x+3=0$ he asks what purpose is subserved by such roots as $-1+\sqrt{-2}$ and $-1-\sqrt{-2}$ and says that they show the generality of the law of formation of the coefficients and are useful of themselves.

Descartes, in his *Geometria*, 1637, gives us no new ideas upon the subject, but is the first to apply the terms real and imaginary by way of contrast to the roots of an equation.

Wallis, in his *Treatise of Algebra*, 1685, leads the van in his endeavor to give a geometric interpretation to the square root of a negative number. In chapter LXVI we read :

> These *Imaginary* Quantities (as they are commonly called) arising from the *Supposed* Root of a Negative Square (when they happen,) are reputed to imply that the Case proposed is Impossible.
>
> And so indeed it is, as to the first and strict notion of what is proposed. For it is not possible that any Number (Negative or Affirmative) Multiplied into itself can produce (for instance) —4. Since that Like Signs (whether + or —) will produce + ; and therefore not —4.
>
> But it is also Impossible that any Quantity (though not a Supposed Square) can be *Negative*. Since that it is not possible that any *Magnitude can be Less than Nothing* or any *Number Fewer than None.*
>
> Yet is not that Supposition (of Negative Quantities,) either Unuseful or Absurd ; when rightly understood. And though, as to the bare Algebraick Notation, it import a Quantity less than nothing. Yet, when it comes to a Physical Application, it denotes as Real a Quantity as if the Sign were +; but to be interpreted in a contrary sense.

He illustrates this by distances measured forward and backward upon a straight line in the usual way, and continues :

> Now what is admitted in Lines must, on the same Reason, be allowed in Plains also.

Having thus justified the existence of negative planes, he goes on:

But now (supposing this Negative Plain, —1600 Perches, to be in the form of a Square;) must not this Supposed Square be supposed to have a Side? And if so, what shall this Side be?

We cannot say it is 40, nor that it is —40 * *

But thus rather that it is $\sqrt{-1600}$, or * * 10 $\sqrt{-16}$, or 20 $\sqrt{-4}$, or 40 $\sqrt{-1}$.

Where $\sqrt{}$ implies a Mean Proportional between a Positive and a Negative Quantity. For like as $\sqrt{bc}$ signifies a Mean Proportional between $+b$ and $+c$; or between $-b$ and $-c$; * * So doth $\sqrt{-bc}$ signify a Mean Proportional between $+b$ and $-c$, or between $-b$ and $+c$.

In chapter LXVII Wallis gives a geometric exemplification of a mean proportional, interpreting $\sqrt{bc}$ as a sine in a circle whose diameter $=b+c$, and $\sqrt{-bc}$ as a tangent in a circle whose diameter $=-b+c$. He then finds the base of a triangle when the two sides and the angle opposite, and hence the altitude, are given. Assuming $AP=20$, $PB=15$, and the altitude $PC=12$, by the use of the triangle BCP, right-angled at C, he obtains two values for the base AB. Then taking $AP=20$, $PB=12$, and the altitude $PC=15$, he finds imaginary values for the base.

These he interprets by saying:

This Impossibility in *Algebra* argues an Impossibility of the case proposed in Geometry; and that the Point B cannot be had, (as supposed,) in the Line AC, however produced (forward or backward,) from A.

Yet there are Two Points designed (out of that Line, but) in the same Plain; to either of which, if we draw the Lines AB, BP, we have a Triangle; whose Sides, AP, PB, are such as were required: And the Angle PAC, and Altitude PC, (above AC, though not above AB,) such as was proposed:

In this case he takes the triangle BCP to be right angled at B. Further:

And (in the Figure,) though not the Two Lines themselves, AB, AB, (as in the First case, where they lay in the Line AC:) yet the Ground-Lines on which they stand, $A\beta$, $A\beta$, are equal to the Double of AC: That is, if to either of those AB, we join Ba, equal to the other of them, and with the same Declivity; ACa (the distance of Aa) will be a Straight Line equal to the double of AC; as is ACa in the First case.

The greatest difference is this; that in the first Case, the Points B, B, lying in the Line AC, the Lines AB, AB, are the same with their Ground-Lines, but not so in this last case where B, B are so raised above β β (the respective Points in their Ground-Lines, over which they stand), as to make the case feasible; (that is, so much as is the versed sine of CB to the Diameter PC:) But in both ACa (the Ground-Line of ABa) is equal to the Double of AC.

So that, whereas in case of Negative Roots, we are to say, The Point B cannot be found, so as is supposed in AC Forward, but Backward from A it may in the same Line: We must here say, in case of a Negative Square, the Point B cannot be found so as was supposed, in the Line AC; but Above that Line it may in the same Plain. This I have the more largely insisted upon, because the Notion (I think) is new; and this, the plainest Declaration that at present I can think of, to explicate what we commonly call the *Imaginary Roots* of Quadratic Equations. For such are these.

From these extracts it is evident that Wallis possessed, at least in germ, some elements of the modern methods of addition and subtraction of directed lines.

For the next hundred years no advance of importance was made. Euler, for example, makes large use of the imaginary, but in his *Algebra*, 1770, he observes:

All such expressions as $\sqrt{-1}$, $\sqrt{-2}$, etc., are consequently impossible or imaginary numbers, since they represent roots of negative quantities; and of such numbers we may truly assert that they are neither nothing, nor greater than nothing, nor less than nothing, which necessarily constitutes them imaginary or impossible.

On the 10th of March, 1797, a surveyor named Wessel presented to the Royal Academy of Sciences and Letters of Denmark a memoir 'On the Analytic Representation of Direction,' which was printed in 1798 and appeared in Vol. V, of the Memoirs of the Academy in 1799.

Caspar Wessel was born June 8, 1745, at Jonsrud, in Norway, where his father was a pastor. Though one of thirteen children, he had a good education, for in 1757 he entered the high school at Christiania and

in 1763 went to Copenhagen to pursue further studies. In 1764 he was engaged by the Academy of Sciences as an assistant in the triangulation and preparation of a map of Denmark. Till 1805 he remained in the continuous employ of the Academy as surveyor. Wessel was highly esteemed by his contemporaries, and for some special work done after leaving the service of the Academy he received the Academy's silver medal and a full set of its memoirs. In 1819, when many of its maps were declared out of date, the trigonometric determinations of Wessel were made a special exception. In 1778 he passed an examination in Roman law. In 1815 he was made a Knight of the Danebrog. He died in 1818.

While Wessel was always well spoken of as a surveyor, he was never mentioned as a mathematician. Still the fact that his paper was the first to be accepted by the Academy from one not a member argues in his favor. This acceptance was due to Tetens, Councillor of State, to whom the MS. had been shown and whose assistance in improving it was acknowledged. In the History of the Academy of Sciences of Denmark published in 1843 Professor Jürgensen classes Wessel with others in the statement, "The treatises of the other mathematicians are monographs of no considerable scientific value," or "They are too special to be discussed more at length."

In the introduction to his memoir Wessel says:

The present essay has for its object to determine how to express segments of straight lines when we wish by means of a unique equation between a single unknown segment and other given segments to find an expression representing at once the length and direction of the unknown segment.

To be able to answer this question I shall employ two considerations which seem to me evident. In the first place, the variation of direction which may be produced by algebraic operations ought also to be represented by their symbols. In the second place we submit direction to algebra only by making its variation depend upon algebraic operations. Now according to the ordinary conception we can transform it by these operations only into the opposite direction, that is, from positive into negative and reciprocally. It follows that these two directions only would be susceptible of an analytic representation adapted to the usual conception and that the solution of the problem would be impossible for other directions. It is probably for this reason that nobody has given attention to this subject. Doubtless nobody has felt at liberty to change the definition of these operations once adopted. To this there is no objection so long as the definition is applied to ordinary quantities; but there are special cases where the peculiar nature of the quantities seems to invite us to give particular definitions to the operations. Then if we find these definitions advantageous it seems to me that we ought not to reject them. For in passing from arithmetic to geometric analysis, that is to say, from operations relative to abstract numbers to operations upon segments of a straight line, we shall have to consider quantities which may have to one another not only the same relations as abstract numbers, but also a great number of new relations. Let us try then to generalize the signification of our operations; let us not restrict ourselves, as has been done hitherto, to the employment of segments of a straight line in the same or opposite senses, but extend a little the notion of the way in which they are applied not only to the same cases as heretofore, but to an infinite number of other cases. If at the same time that we take this liberty we have respect to the ordinary rules of operations we in no way contravene the ordinary theory of numbers, but we merely develop it, we accommodate ourselves to the nature of the quantities and observe the general rule which requires us to render a difficult theory little by little more easy to comprehend. It is not then absurd to demand that in geometry operations be taken in a broader sense than in arithmetic. We shall admit without difficulty that it will be possible to vary the direction of segments in an infinite number of ways. Precisely by this means (as we shall show later) we succeed not only in avoiding all impossible operations and in explaining the paradox that it is necessary sometimes to resort to the impossible to obtain the possible, but we also succeed in expressing the direction of line-segments situated in the same plane quite as analytically as their length, without the memoir being embarrassed by new symbols or new rules. Now it must be agreed that the general demonstration of geometric theorems often becomes easier when we express direction in an analytic manner and submit it to the rules of algebraic operations than when we are compelled to represent it by figures which are applicable only to particular cases.

For these reasons I have proposed to myself:

1° to give the rules of operations of this nature;

2° to show by examples the application to cases where the segments are found in the same plane;

3° to determine by a new method not algebraic the direction of segments situated in different planes;

4° to deduce the general solution of plane and spherical polygons;

5° to deduce in the same way the known formulæ of spherical trignometry.

This, in brief, is an outline of the present memoir. I was led to write it by my desire to find a method which would enable me to avoid impossible operations; having discovered it I have made use of it to convince myself of the generality of certain known formulæ.

How well the author succeeds in carrying out his plan is shown by the memoir itself. Wessel says:

The addition of two segments is effected in the following manner: we combine them by drawing the one from the point where the other terminates; then we join by a new segment the two ends of the broken line thus determined.

He extends the definition to more than two segments and affirms:

In the addition of segments, the order of terms is arbitrary and the sum always remains the same.

His definition of the product of two segments is especially noteworthy:

The product of the two line-segments ought in every respect to be formed with one of the factors in the same way as the other factor is formed, with the positive or absolute segment taken equal to unity; that is to say:

1° The factors ought to have such a direction that they can be placed in the same plane as the positive unit;

2° As to length the product should be to one of the factors as the other is to the unit;

3° As to the direction of the product, if we draw from the same origin the positive unit, the factors and the product, the latter ought to be in the plane of the unit and the factors, and ought to deviate from one of the factors by as many degrees and in the same sense as the other deviates from the unit so that the angle of direction of the product or its deviation with respect to the positive unit is equal to the sum of the angles of direction of the factors.

Let us designate by $+1$ the positive rectilinear unit, by $+\varepsilon$ another unit perpendicular to the first and having the same origin; then the angle of direction of $+1$ will be equal to $0°$, that of -1 to $180°$, that of $+\varepsilon$ to $90°$ and that of $-\varepsilon$ to $-90°$ or to $270°$; and according to the rule that the angle of direction of the product is equal to the sum of the angles of the factors, we shall have: $(+1).\ (+1)=+1$, $(+1).\ (-1)=-1$, $(-1)\cdot(-1)=+1$, $(+1)\cdot(-\varepsilon)=-\varepsilon$, $(-1)\cdot(+\varepsilon)=-\varepsilon$, $(-1)\cdot(-\varepsilon)=+\varepsilon$, $(+\varepsilon)\cdot(+\varepsilon)=-1$, $(+\varepsilon)\cdot(-\varepsilon)=+1$, $(-\varepsilon)\cdot(-\varepsilon)=-1$. Hence it follows that ε is equal to $\sqrt{-1}$ and that the deviation of the product is determined so that we violate none of the ordinary rules of operation.

It is interesting to note that while Wessel makes the addition and multiplication of directed lines a matter of definition, Argand, in his famous memoir of 1806, *Essai sur une manière de représenter les quantités imaginaires dans les constructions géométriques*, says: "Inasmuch as these principles depend upon inductions which are not securely established, they cannot as yet be considered as other than hypotheses whose acceptance or rejection should depend upon either the consequences which they entail or a more rigorous logic," although in his last contribution to the *Annales de Gergonne* he grants that this difficulty will vanish if with M. Français we define what is meant by a ratio of magnitude and position between two lines.

After explaining that if v represents any angle, and $\sin v$ a segment equal in length to the sine, positive when the measuring arc terminates in the first semicircumference and negative when it terminates in the second, $\varepsilon \sin v$ will express the sine of the angle v in direction and magnitude, Wessel shows that any radius making the angle v with the positive unit will equal $\cos v+\varepsilon \sin v$. In the multiplication of two radii $\cos v+\varepsilon \sin v$, $\cos u+\varepsilon \sin u$, he establishes the distributive law by reference to the formulæ,

$$\sin (v+u) = \sin v \cos u + \cos v \sin u,$$
$$\cos (v+u) = \cos v \cos u - \sin v \sin u,$$

in contrast to Argand, who assumes the distributive law and then derives the trigonometric formulæ.

A statement in this connection is noteworthy:

But if we have to multiply line segments which are not both in the plane passing through the absolute unit we cannot apply the preceding rule. For this reason I do not consider the multiplication of such segments.

The treatment of division follows in a natural manner, and it is proved that indirect quantities share with direct quantities the property that if the dividend is a sum we obtain by dividing each term of the sum by the divisor several quotients whose sum is the quotient sought.

Then comes a discussion of powers and roots establishing the fact that $(\cos v + \varepsilon \sin v)^{\frac{1}{m}}$ has m different values and only m. In the next paragraph Wessel shows that the m^{th} power of a line-segment may be put in the form $e^{ma+mb\sqrt{-1}}$, where e^{ma} represents the length and mb the angle of direction, and that thus we have a new method of representing the direction of line-segments in the same plane by the aid of natural logarithms. This last is not again referred to, but it is readily seen that Wessel was in possession of all three of the present methods of representing the complex number,

$a+b\sqrt{-1}$, $r(\cos\varphi+\sqrt{-1}\sin\varphi)$ and $re^{\phi\sqrt{-1}}$.

At the close of this section the author remarks:

At another time, with the permission of the Academy, I will present the complete proofs of these theorems. Having given an account of the way in which we must, in my judgment, understand the sum, the product, the quotient and power of line segments, I shall restrict myself to a few applications of the method.

The first application is to a demonstration of Cotes's theorem in which the fundamental theorem of algebraic equations is assumed as previously established. The second is to the resolution of plane polygons. In this certain characteristic notations occur. The first side of the quadrilateral considered is taken equal to the absolute unit; the sides in order beginning with the first are designated by the even numbers II, IV, VI, VIII, while I, III, V, VII, represent their deviations (in degrees) each with respect to the preceding side prolonged, regarding these deviations as positive or negative according as they have the same sense as the diurnal motion of the sun or the opposite; I′, III′, V′, VII′ denote the expressions $\cos \mathrm{I} + \varepsilon \sin \mathrm{I}$, etc., while $\mathrm{I}^{-\prime}$, $\mathrm{III}^{-\prime}$, $\mathrm{V}^{-\prime}$, $\mathrm{VII}^{-\prime}$ denote the expressions $\cos(-\mathrm{I}) + \varepsilon \sin(-\mathrm{I})$ or $\cos \mathrm{I} - \varepsilon \sin \mathrm{I}$, etc.

The author then deduces the two formulæ,

$$\mathrm{II} + \mathrm{IV} \cdot \mathrm{III}' + \mathrm{VI} \cdot \mathrm{III}' \cdot \mathrm{V}' + \mathrm{VIII} \cdot \mathrm{III}' \cdot \mathrm{V}' \cdot \mathrm{VII}' = 0,$$

$$\mathrm{II} \cdot \mathrm{III}' \cdot \mathrm{V}' \cdot \mathrm{VII}' + \mathrm{IV} \cdot \mathrm{V}' \cdot \mathrm{VII}' + \mathrm{VI} \cdot \mathrm{VII}' + \mathrm{VIII} = 0,$$

and proves that two equations of this form will suffice for the solution of any polygon in which the only unknown parts are three angles, or two angles and a side, or an angle and two sides.

Wessel next attacks the problem of representing the direction of any line segment in space by taking it as the radius, r, of a sphere. Assuming three perpendicular radii as axes and denoting positive unit lengths upon these, to the left by 1, forward by ε and upward by η respectively, where $\varepsilon^2 = -1$, and $\eta^2 = -1$, he concludes that a radius whose extremity has for coordinates $x, \eta y, \varepsilon z$ will be properly designated by $x + \eta y + \varepsilon z$. Defining the plane of r and εr as the horizontal plane and that of r and ηr as the vertical plane, he examines the effect of moving the extremity through an arc of I degrees parallel to the horizontal plane and obtains for $x + \eta y + \varepsilon z$ the new value,

$$\eta y + (x + \varepsilon z)(\cos \mathrm{I} + \varepsilon \sin \mathrm{I}) = \eta y + x \cos \mathrm{I} - z \sin \mathrm{I} + \varepsilon x \sin \mathrm{I} + \varepsilon z \cos \mathrm{I},$$

in which the term ηy remains unchanged. This operation he indicates by the use of

the sign ,, as $(x + \eta y + \varepsilon z)$,, $(\cos \mathrm{I} + \varepsilon \sin \mathrm{I})$ and says that it has only imperfectly the signification of a sign of multiplication, for the operation leaves unchanged that one of the segments occurring in the multiplicand which is outside of the plane corresponding to the rotation indicated by the multiplier. He calls attention to the fact that the factors must be used in order from left to right. Similarly when the extremity of the radius moves through an arc of II degrees parallel to the vertical plane we have

$$(x + \eta y + \varepsilon z) ,, (\cos \mathrm{II} + \eta \sin \mathrm{II}) = \varepsilon z + x \cos \mathrm{II} - y \sin \mathrm{II} + \eta x \sin \mathrm{II} + \eta y \cos \mathrm{II}.$$

It follows at once that

$$(x + \eta y + \varepsilon z) ,, (\cos \mathrm{I} + \varepsilon \sin \mathrm{I}) ,, (\cos \mathrm{III} + \varepsilon \sin \mathrm{III}) = (x + \eta y + \varepsilon z) ,, (\cos (\mathrm{I} + \mathrm{III}) + \varepsilon \sin (\mathrm{I} + \mathrm{III}))$$

and

$$(x + \eta y + \varepsilon z) ,, (\cos \mathrm{II} + \eta \sin \mathrm{II}) ,, (\cos \mathrm{IV} + \varepsilon \sin \mathrm{IV}) = (x + \eta y + \varepsilon z) ,, (\cos (\mathrm{II} + \mathrm{IV}) + \varepsilon \sin (\mathrm{II} + \mathrm{IV}))$$

also that

$$x + \eta y + \varepsilon z = (x + \eta y + \varepsilon z) ,, (\cos I + \varepsilon \sin \mathrm{I}) ,, (\cos \mathrm{I} - \varepsilon \sin \mathrm{I}) = (x + \eta y + \varepsilon z) ,, (\cos \mathrm{II} + \eta \sin \mathrm{II}) ,, (\cos \mathrm{II} - \eta \sin \mathrm{II}).$$

Wessel then studies the effect of alternate horizontal and vertical rotations. Representing the radius in its first position by s and in its final position by S, and denoting the arcs in order by I, II, III, * * * *VI*, he obtains the formula

$$S = s ,, \mathrm{I}' ,, \mathrm{II}' ,, \mathrm{III}' ,, \mathrm{IV}' ,, \mathrm{V}' ,, \mathrm{VI}'.$$

In this connection he observes that such factors as V′ ,, VI′ can be transferred to the first member by using their reciprocals in inverse order, as

$$S ,, \mathrm{VI}^{-\prime} ,, \mathrm{V}^{-\prime} ,, \mathrm{IV}^{-\prime} = s ,, \mathrm{I}' ,, \mathrm{II}' ,, \mathrm{III}' ,, .$$

These results are applied to the solution of spherical polygons and the determination of the properties of spherical triangles. As in the case of plane polygons, I, II, III, etc., represent the exterior angles and sides in order, the odd numbers the angles, and the even numbers the sides. Supposing the angles and the sides of a polygon known except one angle and two sides, or two angles and a side, or three angles, or three sides, the unknown parts can be determined by the equation

$$s ,, \mathrm{I}' ,, \mathrm{II}' ,, \mathrm{III}' ,, \mathrm{IV}' ,, \mathrm{V}' ,, \mathrm{VI}' ,, \ldots ,, N' = s,$$

where s is indeterminate, and may be supposed equal to r, εr, or ηr. The effect of the rotations indicated by this equation is to submit the sphere alternately to rotations about the axis of the horizon and the axis of the vertical circle so that each point of the sphere describes first a horizontal arc which measures the first exterior angle of the polygon, then a vertical arc containing as many degrees as the first side of the polygon, then a new horizontal arc which measures the second angle, etc. The sphere finally returns to its original position, while each of its points has described as many horizontal arcs as the polygon has angles and as many vertical arcs as it has sides.

While Wessel's results, as obtained by these alternate rotations, are correct so far as they go, he fails to observe that a general rotation must be compounded of three rotations about the axes ε, η, ε or η, ε, η. Stranger still he makes no study of rotations about the real axis. Thiele, in his introduction to Wessel's memoir, shows how easy it would have been to go a few steps further and arrive at the notion of quaternions. But be that as it may, Wessel deserves great credit for having devised the only successful method of dealing with line-segments in space previous to the work of Hamilton beginning in 1843.

Unmindful of Euler's demonstration of the real value of $(\sqrt{-1})^{\sqrt{-1}}$ Argand endeavors to show that such an expression may be used to represent a directed line in

space. Français tries to solve the problem by the use of imaginary angles, but frankly acknowledges his failure. Servois sees with remarkable clearness what is needed, but is unable to reach it. He says:

The table of double argument which you (Gergonne) propose, as applied to a plane supposed to be so divided into points or *infinitesimal* squares that each square corresponds to a number which would be its *index*, would very properly indicate the length and position of the radii vectores which revolve about the point or central square corresponding to ± 0; and it is quite remarkable that if we designated the length of a radius vector by a, and the angle it makes with the real line......, -1, ± 0, $+1$...... by α, the rectangular coordinates of its *extremity remote from the origin* by x, y, the real line being the axis of x, the point would be determined by $x+y\sqrt{-1}$...... It is clear that your ingenious tabular arrangement of numerical magnitudes may be regarded as a central slice (*tranche centrale*) of a table of triple argument representing points and lines in tri-dimensional space. You will doubtless give to each term a trinomial form; but what would be the coefficient of the third term? For my part I cannot tell. Analogy would seem to indicate that the trinomial should be of the form $p\cos\alpha+q\cos\beta+r\cos\gamma$, α, β, and γ being the angles made by a right line with three rectangular axes and that we should have

$$(p\cos\alpha+q\cos\beta+r\cos\gamma)\ (p'\cos\alpha+ q'\cos\beta+r'\cos\gamma) = \cos^2\alpha+\cos^2\beta+\cos^2\gamma=1.$$

The values of p, q, r, p', q', r' satisfying this condition would be *absurd*, but would they be imaginaries, reducible to the general form $A+B\sqrt{-1}$?

As we all know now, these non-reals which Servois could not determine may be identified with the $+i$, $+j$, $+k$, $-i$, $-j$, $-k$, of Hamilton's Quaternions.

In 1799, in his first published paper, *Demonstratio nova theorematis omnem functionem algebraicam rationalem integram unius variabilis in factores reales primi vel secundi gradus resolvi posse*, the celebrated Gauss, then only twenty-two years of age, says:

By an imaginary quantity I always understand here a quantity contained in the form $a+b\sqrt{-1}$, so long as b is not zero. * * * If imaginary quantities are to be retained in analysis (which for many reasons seems better than to abolish them, provided they are established on a sufficiently solid foundation) it is necessary that they be considered as equally possible with real quantities, on which account I should prefer to include both real and imaginary quantities under the common designation *possible quantities*. * * * A vindication of these (*i. e.*, imaginary quantities), as well as a more fruitful exposition of the whole matter, I reserve for another occasion.

This occasion, however, does not seem to have come till more than thirty years later. In the *Göttingische gelehrte Anzeigen* of April 23, 1831, in an account by Gauss of his own paper *Theoria residuorum biquadraticorum, Commentatio secunda*, we read:

Our general arithmetic, so far surpassing in extent the geometry of the ancients, is entirely the creation of modern times. Starting originally from the notion of absolute integers, it has gradually enlarged its domain. To integers have been added fractions, to rational quantities the irrational, to positive the negative and to the real the imaginary. This advance, however, has always been made at first with timorous and hesitating step. The early algebraists called the negative roots of equations false roots, and these are indeed so when the problem to which they relate has been stated in such a form that the character of the quantity sought allows of no opposite. But just as in general arithmetic no one would hesitate to admit fractions, although there are so many countable things where a fraction has no meaning, so we ought not to deny to negative numbers the rights accorded to positive simply because innumerable things allow no opposite. The reality of negative numbers is sufficiently justified since in innumerable other cases they find an adequate substratum. This has long been admitted, but the imaginary quantities—formerly and occasionally now, though improperly, called impossible—as opposed to real quantities are still rather tolerated than fully naturalized, and appear more like an empty play upon symbols to which a thinkable substratum is denied unhesitatingly by those who would not depreciate the rich contribution which this play upon symbols has made to the treasure of the relations of real quantities.

The author has for many years considered this highly important part of mathematics from a different point of view, where just as objective an existence may be assigned to imaginary as to negative quantities, but hitherto he has lacked opportunity to publish these views, though careful readers may find traces of them in the memoir upon equations which appeared in 1799 and again in the prize memoir upon the transformation of surfaces. In the present paper

the outlines are given briefly; they consist of the following:

Positive and negative numbers can only find an application when the thing counted has an opposite which when conceived of as united with it has the effect of destroying it. Accurately speaking, this supposition can only be made where the things enumerated are not substances (objects thinkable in themselves), but relations between any two objects. It is postulated that these objects are arranged after a definite fashion in a series, *e. g.*, A, B, C, D, * * * and that the relation of A to B can be regarded as equal to that of B to C, etc. The notion of opposition involves nothing further than the *interchange* of the terms of the relation so that if the relation of (or transition from) A to B is considered as $+1$ the relation of B to A must be represented by -1. So far then as such a series is unlimited on both sides, every real integer represents the relation of a term arbitrarily taken as origin to a definite term of the series.

If, however, the objects are of such a kind that they cannot be arranged in one series, even though unlimited, but only in series of series, or, what amounts to the same thing, they form a manifoldness of two dimensions; if there is the same connection between the relations of one series to another, or the transitions from one to another, as in the case of the transition from one term of a series to another term of the same series, we shall evidently need for the measurement of the transition from one term of the system to another, besides the previous units $+1$ and -1, two others opposite in character $+i$ and $-i$. Obviously we must also postulate that the unit i shall always mark the transition from a given term of the one series to a definite term of the immediately adjacent series. In this way the system can be arranged in a two-fold manner in series of series.

The mathematician leaves entirely out of consideration the nature of the objects and the content of their relations. He has simply to do with the enumeration and comparison of the relations. So far as he has assigned sameness of nature to the relations designated by $+1$ and -1, considered in themselves, he is warranted in extending such sameness to all four elements $+1$, -1, $+i$, $-i$.

These relations can be made intuitive only by a representation in space and the simplest case, where there is no reason for arranging the objects in any other than quadratic fashion, is that in which an unlimited plane is divided into squares by two systems of parallel lines intersecting at right angles, and the points of intersection are selected as the symbols. Every such point has four adjacent points, and if we designate the relation A to a neighboring point by $+1$, the relation to be denoted by -1 is determined of itself, while we can select which of the two others we please for $+i$, or can take the point to be denoted by $+i$ at pleasure on the *right* or *left*. This distinction between right or left so soon as we have fixed (at pleasure) upon forwards and backwards *in* the plane, and above and below with respect to the two sides of the plane is completely determined *in itself*, although we can convey our own intuition of this difference to others *only* by reference to actually existent material things. But when we have decided upon the latter we see that it is still a matter of choice as to which of the two series intersecting at one point we shall regard as the principal series and which direction in it shall be considered as having to do with positive numbers. We see further that if we wish to take $+1$ for the relation previously expressed by $+i$, we must necessarily take $+i$ for the relation previously expressed by -1. In the language of mathematicians this means that $+i$ is *a* mean proportional between $+1$ and -1, or corresponds to the symbol $\sqrt{-1}$. We say purposely not *the* mean proportional because $-i$ has just as good a right to that designation. Here then the demonstrability of an intuitive signification of $\sqrt{-1}$ has been fully justified and nothing more is necessary to bring this quantity into the domain of objects of arithmetic.

We have thought to render the friends of mathematics a service by this brief exposition of the principal elements of a new theory of the so-called imaginary quantities. If people have considered this subject from a false point of view and thereby found a mysterious obscurity, this is largely due to an unsuitable nomenclature. If $+1$, -1, $\sqrt{-1}$ had not been called positive, negative, imaginary (or impossible) unity, but perhaps direct, inverse, lateral unity, such obscurity could hardly have been suggested. The subject which, properly enough, in the present treatise has been touched upon only incidentally the author has reserved for a more elaborate treatment in the future where also the question will be answered as to why the relations between things which present a manifoldness of more than two dimensions cannot furnish still other classes of magnitudes admissible in general arithmetic.

Such was Gauss's masterly presentation of the underlying principles of the treatment of the imaginary. In Germany the impulse given by his commanding influence is felt even to the present day.

Buée's memoir *Sur les Quantités Imaginaires*, read before the Royal Society of London in 1805 and covering 65 pages of the Philosophical Transactions of 1806, is somewhat

vague and disappointing. He describes $\sqrt{-1}$ as follows:

> $\sqrt{-1}$ is the sign of perpendicularity $\sqrt{-1}$ is not the sign of an arithmetical operation, nor of an arithmetico-geometric operation, but of an operation purely geometric. It is a purely descriptive sign which indicates the direction of a line without regard to its length.

Near the close of his paper he investigates what becomes of the conic sections when their coordinates become imaginary and decides that the circle passes into an equilateral hyperbola in the plane perpendicular to the plane of the circle and similarly for the other conics.

A further discussion of the justly celebrated epoch-making memoir of Argand and the contributions of himself, Français-Gergonne and Servois to the *Annales de Gergonne* from 1813 to 1815 is rendered the less necessary by reason of Houel's republication of all these papers in 1874 and their translation into English by Hardy in 1881.

It is interesting to note the early view of imaginaries entertained by so distinguished a mathematician as Cauchy. In his *Cours d' Analyse*, 1821, we read:

> In analysis we apply the term symbolic expression or symbol to every combination of algebraic signs which signifies nothing by itself or to which we attribute a value different from that which it naturally ought to have. * * * * Among the symbolic expressions whose consideration is of importance in analysis we ought especially to distinguish those which are called imaginary. * * * * We write the formula
>
> $$\cos(a+b)+\sqrt{-1}\sin(a+b)=$$
> $$(\cos a+\sqrt{-1}\sin a)(\cos b+\sqrt{-1}\sin b).$$
>
> The three expressions which the preceding equation contains * * * * are three symbolic expressions which cannot be interpreted according to generally established conventions and represent nothing real. * * * * The equation itself, strictly speaking, is inexact and has no meaning.

In 1849, however, in a paper *Sur les quantités géométriques*, in which he gives suitable credit to Argand, Français and others, he acknowledges:

> In my *Analyse algébrique*, published in 1821, I was content to show that the theory of imaginary expressions and equations could be rendered rigorous by considering these expressions and equations symbolic. But after new and mature reflections the better side to take seems to be to abandon entirely the use of the sign $\sqrt{-1}$ and to replace the theory of imaginary expressions by the theory of quantities which I shall call geometric.

Having defined the term geometric quantity exactly as we now define the term vector and shown when two geometric quantities are equal, he continues:

> The notion of *geometric quantity* will comprehend as a particular case the notion of *algebraic quantity*, positive or negative, and *a fortiori* the notion of *arithmetic quantity*. * * * We must further define the different functions of these quantities, especially their sums, their products and their integral powers by choosing such definitions as agree with those admitted when we are dealing with algebraic quantities alone. This condition will be fulfilled if we adopt the conventions now to be given.

Then follow the definitions called for, together with a treatment of the whole subject fully up to modern demands. Cauchy observes that a large part of the results of the investigations of Argand and others would seem to have been discovered as early as 1786 by Henri Dominique Truel, who communicated them about 1810 to Augustin Normand, of Havre.

In 1828 there appeared in Cambridge, England, a remarkable work by Rev. John Warren, entitled *A Treatise on the Geometrical Representation of the Square Roots of Negative Quantities.* Though this book has latterly received scant credit, its merits were fully recognized by De Morgan and acknowledgments of indebtedness were frankly made by Hamilton.

Throughout Warren's work the term quantity, like Cauchy's geometric quantity, indicates a line given in length and direction. Some of his definitions are as follows:

> The sum of two quantities is the diagonal of the parallelogram whose sides are the two quantities. The first of four quantities is said to have to the

second the same ratio which the third has to the fourth; when the first has *in length* to the second the same ratio which the third has *in length* to the fourth, according to Euclid's definition; and also the angle at which the fourth is inclined to the third is equal to the angle at which the second is inclined to the first, and is measured in the same direction. Unity is a positive quantity arbitrarily assumed from a comparison with which the values of other quanties are determined. If there be three quantities such that unity is to the first as the second to the third, the third is called the *product*, which arises from the *multiplication* of the second by the first. If there be three quantities such that the first is to unity as the second is to the third, the first quantity is called the *quotient*, which arises from the *division* of the second by the third.

The fundamental laws of algebra as governing these quantities are established in their utmost generality with a rigor of reasoning that has probably not been surpassed. The author even goes so far as to deduce the binomial formula, to develop many series and to apply the methods of the differential and integral calculus to quantities of the class defined. In form Warren's work is intensely algebraic and fairly bristles with formulæ.

To sum up:

Caspar Wessel, in 1797, published the first clear, accurate and scientific treatment of directed lines in the same plane, as represented by quantities of the form $a+b\sqrt{-1}$, establishing the laws governing their addition, subtraction, multiplication and division, and showing these quantities to be of practical value in the demonstration of theorems and solution of problems; he also worked out a partial theory of rotations in space, so far as they can be decomposed into rotations about two axes at right angles.

Not very much later, 1799, Gauss indicated that he was in possession of a method of dealing with quantities of the form $a+b\sqrt{-1}$ which would consider them as equally possible with real quantities, but its fuller exposition was deferred till 1831.

Buée's paper of 1805 lays great emphasis upon $\sqrt{-1}$ as the sign of perpendicularity, but fails to give any satisfactory interpretation of the product of directed lines.

Argand's famous memoir of 1806 is hardly in danger of receiving too much credit. Though written after Wessel's paper there is not the slightest probability that Argand had any knowledge of the Norwegian surveyor, and, in fact, certain of his theorems are established less rigorously than by Wessel. Argand gave numerous applications of his theory to trigonometry, geometry and algebra, some of which are very noteworthy, especially his demonstrations of Ptolemy's theorem regarding the inscribed quadrilateral and of the fundamental proposition of the theory of equations.

The contributions of Français, Gergonne and Servois, 1813–1815, served to do away with some of the errors into which Argand had fallen and thus to give a clearer insight into the fundamental notions of the subject.

Though Warren's book of 1828 contains definitions differing but little from those of Wessel and Français and a notation which seems only a modification of that of Français, his generalized treatment of directed lines in the plane must be regarded as highly original.

Cauchy's work lay in the extension and development of the labors of his predecessors rather than in the introduction of new ideas.

Such were the beginnings of the study of the geometric representation of the imaginary which has led in modern times to the establishment of such great bodies of doctrine as the theory of functions on the one side and quaternions on the other, with the Ausdehnungslehre occupying a position between. Who can tell what the next century will bring forth?

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*EIMER'S EVOLUTION OF BUTTERFLIES.**

THE criticism, by Professor Minot, of the second part of Eimer's work, *'Artbildung und Verwandtschaft bei den Schmetterlingen,'* which appeared in SCIENCE at the beginning of last year (January 3, 1896, Vol. III., No. 53), gives me occasion to again explain Eimer's evolutionary theory, which, so far as I can see from Minot's article, has in many respects been misunderstood. It seems as though Minot were not well acquainted with Eimer's earlier works on the markings of animals, works in which questions of evolution were already discussed. And, as Eimer's present views on this subject are chiefly founded on the results of these earlier works, it is easy to understand why many assertions which need these results for their proof, seem incomprehensible to Minot. Minot calls Eimer 'an enthusiastic opponent of Darwin's theory of natural selection.' It is true that through his investigations on the markings of different groups of animals Eimer became more and more confirmed in his opinion that natural selection was of no moment for the origin of species. This view is expressed in the 'Butterflies,' with the distinct reservation (see p. 68) that he acknowledges the efficiency of natural selection in preserving and intensifying such characters as have previously been developed by other agencies to such an extent as to become useful to the organism in question. Eimer, then, occupies the same position that Mivart defended against Darwin (see 'Origin of Species', Germ. ed., 1876, p. 249 ff.) and he is a decided opponent of the teleological views spread by some of Darwin's followers rather than by the latter himself.

According to Eimer species originate by organic growth, a term first defined by him in his 'Origin of Species.' In the constitutional changes which organisms undergo during life in consequence of external influences, such as climate, food, etc., he sees the first agents that cause the development of new characters. These changes first reveal themselves as growth-phenomena. It is the struggle for existence that gives rise to selection from among these changes, that rejects or adopts. I must consider it a misrepresentation to call this view of the origin of species a bold hypothesis. It is merely the result of investigations which prove plainly that, in the more sensitive representatives of a species, external influences can and do produce individual variations, and that we find these as aberrations in contiguous districts and as species in those that are more distant. Eimer first mentions this thesis in his work on *'Das Variiren der Mauereidechse'** and makes it probable by his observations; more striking proofs, however, are given in his work on the 'Evolution of Butterflies.' Our native horadimorph butterflies, such as *Vanessa levana* and *V. prorsa*, *Pieris bryoniae* and *napi*, make it sufficiently obvious that external influences are no indifferent factors in the formation of organisms. A variation of temperature to which the chrysalis is exposed produces, from the eggs of one and the same species, butterflies which differ so much in their external structure that for a long time they were held to be separate species. Dorfmeister† and Weismann‡

*Die Artbildung und Verwandtschaft bei den Schmetterlingen, II. Teil., von Dr. G. H. Th. Eimer, und Dr. C. Fickert. Jena, G. Fischer, 1895.

*Eimer: Untersuchungen über das Variiren der Mauereidechse, ein Beitrag zur Theorie von der Entstehung aus konstitutionellen Ursachen. Archiv. f. Naturgeschichte (und selbständig). Berlin, Nicolai, 1881.

† Dorfmeister: Über die Einwirkung verschiedener während der Entwicklungsperioden angewendeter Wärmegrade auf die Färbung und Zeichnung der Schmetterlinge. Mitteilungen d. naturw. Vereins für Steiermark, 1864.

‡ A. Weismann: Studien zur Descendenztheorie I. Über den Saisondimorphismus d. Schmetterlinge, 1875.

showed by experiment—they let the chrysalids of the *prorsa* generation develop at low temperature, those of the *levana* at high temperature—that both butterflies belong to one and the same species. Similar experiments have of late been made by Merrifield* and Standfuss† and have revealed still more astonishing phenomena in a great number of butterflies. They all tend to prove that the forms developed in heat or in cold respectively, always possess those qualities which characterize variations and nearly allied species of these butterflies living exclusively in warmer or colder climates. And not only the markings, but also the form of the wings and the whole configuration of the animal change. In his criticism Minot does not so much as mention these facts, which Eimer regards as a proof that the views on which his theory is based are correct; on the contrary, he particularly emphasizes that Eimer's theories are founded only on the study of the markings of animals and the geographical distribution of forms. It is true that, guided by the results of his earlier researches, Eimer regards these markings as the most characteristic signs of affinity between the various species.‡ And he considers as a further proof of the correctness of this assumption the results of the artificial development of butterflies in lower or higher temperatures in their relation to the geographical connection of forms.

*F. Merrifield: Transactions of the Entomolog. Soc. of London, 1893–94.

†Standfuss: Über die Gründe der Variation und Aberration des Falterstadiums bei den Schmetterlingen mit Ausblicken auf die Entstehung der Arten. Leipzig, 1894. The same: Handbuch für Sammler der europäischen Grosschmetterlinge. Zürich, 1891.

‡Darwin also came to the same conclusion, as he says: "We shall hereafter see, especially in the chapter on Pigeons, that coloured marks are strongly inherited and that they often aid us in discovering the primitive forms of our domestic races." Animals and Plants under Domestication, Vol. I., p. 29. London, 1868.

Eimer's theory further materially differs from that of Natural Selection in its explanation of liabilities and tendencies to changes.

Natural selection presupposes the most varied liabilities to changes, in order to become efficient in the production of forms; Eimer, on the contrary, is of opinion that individuals can only follow prior determined, *i. e.*, definite tendencies of evolution (not predetermined tendencies, as Minot wrongly understands). This 'Orthogenesis,' in opposition to Nägeli's view, does not always tend towards perfection, but often towards simplification and retrogression. In its rudiments this law shows itself in the markings of animals, inasmuch as the primitive form of longitudinal stripes becomes spots, transverse stripes, and uniformity of color. This rule, which Minot wishes to be 'proved, not proclaimed *ex cathedra*,' is followed, as is shown by Eimer's researches, by the ontogenesis and phylogenesis of reptiles,* birds,† and mammalia. Simroth‡ found this law confirmed in Limaces, I myself in the markings on the shells of marine gastropods.§ Although the physiological cause and, therefore, the necessity of this curious phenomenon has not yet been ascertained, yet, as it repeats itself in so many different groups of animals, it cannot be denied the importance of a fact. Hyatt's‖

*Eimer: Zoologische Studien auf Capri II., *Lacerta muralis coerulea.* Leipzig, Engelmann, 1874.

†The same: Die Zeichnung d. Vögel und Säugetiere. Württemb. Naturwiss. Jahreshefte, 1883. The same: Über die Zeichnung der Tiere; Zool. Anzeiger, 1882, 1883, 1884, and in the Zeitschrift Humboldt, 1885–88. The same: Mitteilungen über die Zeichnung der Säugetiere, Schmetterlinge u. Mollusken. Tageblatt der 28. Versammlung deutscher Naturforscher u. Aerzte in Strassburg, 1885, p. 408.

‡Simroth: Versuch einer Naturgeschichte der deutschen Nacktschnecken und ihrer europäischen Verwandten, Zeitschrift. f. wiss. Zoolog. Bd. XLII.

§Gräfin von Linden: Die Entwicklung der Skulptur u. der Zeichnung bei den Gehäuseschnecken des Meeres: Zeitschrift f. wiss. Zoologie. Bd. LIX.

‖A. Hyatt: Genesis of the Arietidae. Smithsonian

and Würtenberger's* works and my own investigations of the shells of Molluscs have shown that other morphological characteristics apart from the markings produce regular changes in a definite direction. Taking this into consideration I do not consider it a 'bold hypothesis' on Eimer's part, when he believes he has found a confirmation of his law of markings in the case of butterflies, for "any hypothesis which explains various large and independent classes of facts rises to the rank of a well-grounded theory." (See Darwin, Animals and Plants under Domestic. Vol. I., p. 8, 1868.) In the systematic part of his two volumes on 'Butterflies' Eimer shows how seemingly insignificant variations of the markings from the original form invariably develop into definite characteristics of new aberrations and species, the changes being dependent upon physiological conditions. It can therefore not be asserted that butterflies are subject to the most multifarious liabilities to change. The markings of *Segelfalter* and of Swallow-tails can be reduced to one common scheme, which, as the illustrations show, is most simply represented by the markings of *Papilio Podalirius*. This scheme of markings consists of eleven bands which extend over the wings in a fixed direction parallel to the axes of the body. They are called longitudinal bands and are always connected with certain veins of the wings. These eleven bands can undergo several variations. They can become broader and vanish altogether by means of lateral combination, become shorter in the direction from the abdomen or head, and sometimes quite disappear, or develop into single spots and form a transverse marking by means of dark colored scales which show themselves on the transverse veins of the wings. In this way the *Segelfalter*, as well as the Swallow-tails, develop new forms, which, from showing only slight aberrations from the original form in the beginning of the evolutional series, differ materially from it in the end. The same law which thus determines the evolution of the members of a group also determines that of the groups themselves. Each succeeding one begins its development at a somewhat higher stage than its predecessor. Variations which are an exception in the lower groups become the rule in the higher ones. This is the reason why the representatives of the first groups of the *Segelfalter* "have markings very similar to the original form, while the third group contains butterflies which closely resemble the Swallow-tails."

The primitive Swallow-tails have attained a much higher degree of development than the primitive *Segelfalter*, but still it is not difficult to recognize that, although they are not immediately allied to the *Segelfalter*, yet their development follows the same direction. The Swallow-tails still possess indications of a separation of bands, which in the *Segelfalter* have coalesced. Furthermore, fragments of markings which still occur in forms closely related to the Swallow-tails show that the development of their markings depends on the same conditions as those of the *Segelfalter*. It would lead me too far to describe in detail the directions of evolution which manifest themselves in the various groups. I will only mention that the tendency of the bands to broaden and to coalesce can be traced throughout the entire groups of *Segelfalter* and has produced almost melanotic forms in the group of *Asterias* of the Swallow-tails. Further, the shortening of the bands from abdomen to head is characteristic of both *Segelfalter* and Swallow-tails. In both groups the

Contrb. to Knowledge, 1889. The same: Phylogeny of an Acquired Characteristic. Proceedings of the Amer. Philosoph. Soc., Vol. XXXII., No. 143, 1895.

*Würtenberger: Studien über die Stammesgeschichte der Ammoniten, Leipzig, 1880.

bands become spots and combine into a transverse marking by the agency of dark colored scales on the transverse veins. If we neglect secondary differences of markings in the two groups of *Papilio*, we have to assume that they originated in complete independence of each other—a direct relationship cannot be proved—according to the same definite laws of development.

In entire groups as well as in single species, no matter whether they live in the same or in different districts, the law of a definite direction of evolution is shown in homogenesis, or independent similarity of evolution. As examples, Eimer cites the North American *Turnus* and the south European *Alexanor* (which is also found in Asia Minor), of *Segelfalter* the South American *Agesilaus*, *Protesilaus* and the European *Podalirius*.

The phenomenon of homogenesis is of importance as a proof that it is not geographical distribution in the sense of local separation on which the development of different directions of evolution depends.

This short exposition of the direction of evolution in the genus *Papilio* seems to me to show that it was not arbitrariness on Eimer's part to select *Papilio Podalirius* as the ancestral form of his group of butterflies. He has shown, by his study of the markings of one series of forms, that those of all its members can be reduced to one and the same scheme, and that aberrations from the forms which are nearest to this original scheme of markings vary so as to form transitions to nearly allied species, which again are connected with more distant species, and the conclusions drawn from the study of these phenomena are confirmed by the results of geographical distribution. This being so, I cannot understand how Minot can doubt that Eimer's assertions are correct.

Neither does Minot agree with the explanation of the sudden appearance of a second perfectly dark-colored form of the feminine *Papilio Turnus* by 'development by jumps' (*Halmatogenesis*). This singular form of feminine *Turnus* called *var. Glaucus*, which occurs exceptionally in the North and regularly as a summer generation in the South of the United States, seems not to be connected by any transitions with the normal feminine animal. Minot, however, believes it possible that in former times transitional forms existed. It seems to me a matter of course that a highly developed form like *Papilio Turnus var. Glaucus* has to undergo several variations of markings during the chrysalis stage before it can leave it in its present form. But in comparison with the difference between the variation of another species and its original form, that between *Turnus* and *var. Glaucus* remains just as striking, whether we know that during the chrysalis stage forms of transition temporarily occur or that in former times forms existed which made the transition from the normal feminine *Turnus* to the *var. Glaucus* somewhat more gradual. As it at present appears, *var. Glaucus* is a form produced by *Halmatogenesis*. Eimer's theory necessarily leads to the conviction that qualities produced by external influences are transmitted to the descendants of those who have acquired them, an assumption for which Minot demands proofs. The experiments of Weismann on *Polyommatus phlœas*, which are mentioned in the *Zoologische Jahrbücher*, 1895, *Abteilung für Systematik*, show that this transmission of qualities from their possessor to his descendants really occurs.

It is by no means every individual that undergoes a change through the influence of unaccustomed external influences. Several preserve the parental aspect. And as the parental characteristics were not from the beginning such as they are at present, but are, as is shown by experiment, the result of certain conditions, the transmission

to the descendant of these parental characteristics which have also been acquired is the clearest proof of the heredity of acquired characteristics.

In spite of all his objections to the theoretical part of Eimer's work, Minot allows that the 'Butterflies' are "valuable from the standpoint of the systematic entomologist, since his groups are natural ones and his grouping of the species is in the main correct."

In his grouping of the butterfly species Eimer was guided by those laws which his study of the markings of other groups of animals had caused him to regard as the general rule, and which he therefore considers himself entitled to apply hypothetically to butterflies. The grouping of species being admitted by Minot to be natural, this is sufficient proof of the correctness of those theories which this grouping presupposes. In designating those groups as natural ones in which longitudinally striped forms develop into spotted, transversely striped and unicolored ones, Minot acknowledges the law of evolution of markings in its full significance.

Darwin, himself, in his 'Origin of Species,' employs similar proofs to show that the same groups of pigeons are descendants of *Columba livia*. Their phylogenetic connection is to him proved by the fact of elements of the markings of *Columba livia* appearing in the plumage of our tame pigeons.

The ontogenetic development of those groups of animals the markings of which Eimer has studied is to him a valuable argument for the correctness of the law laid down for their phylogenesis. Similar investigations made by E. Haase on the evolution of the markings on the wings of the chrysalis of *Papilio Podalirius*, in so far as his limited materials permitted decisive conclusions, completely confirm Eimer's assertions.

These and other researches on the same subject led me to make similar investigations, the results of which I am about to publish. They furnish the best proofs for the laws found by Eimer. My specimens showed that not only single characteristics develop in the way described by Eimer, but that the markings of *Papilio Podalirius* or *Machaon*, as a whole, undergo an evolution in which the degrees of *Alebion*, *Glycerion* or the *Turnus* group are clearly distinguishable.

It would be of great interest to investigate the American forms of *Papilio* in order to see whether Eimer's 'bold hypotheses,' as Minot calls them, apply here. On the basis of arguments which have hitherto been considered customary and convincing in biology, I believe I have shown that Eimer far from rejecting Darwin's theory as a whole, because 'it does not explain the origin of variations.' He knows as well as Minot that Darwin does not even attempt an explanation of their origin. As, however, the theory of the origin of species demands an explanation of the origin of new characters, Darwin has not, as Eimer shows, explained that which he wished to explain. Eimer, on the contrary, shows in the 'Butterflies' how new qualities develop; he explains the causes of their formation and traces the laws of their development. This necessarily led to his well founded theory of the origin of species by means of variations and their propagation. The arguments contained in the 'Butterflies' must convince anybody who examines them somewhat more closely than Minot, that, as Eimer shows, variations and, therefore, the origin of species do not take place arbitrarily in the most varied, but according to Orthogenesis in a few absolutely definite, directions, not influenced by any sort of natural selection and without any reference to teleology. Eimer's theory of orthogenesis, proved as it is by facts, certainly negatives the function of

natural selection as a transforming factor, but acknowledges its preserving and intensifying power. This is the only concession that can be made to the theory of natural selection as long as the results of Eimer's investigations have not been refuted by facts, not, as heretofore, by words. Till then, I believe, one cannot deny to Eimer's work the appreciation contained in Minot's introductory sentences: "If Professor Eimer's claims are correct, his researches mark one of the great epochs of biological discovery."

I wish to state that this is merely a preliminary exposition of Eimer's views, intended for rectifying the erroneous judgment expressed by Minot. Eimer's work on organic evolution (Macmillan, 1889) gives a detailed account of his theoretical views and of the facts on which they are based. His work on Butterflies, which was criticised by Minot, serves to furnish further corroboration of the theory advanced in the above work on evolution. In his lecture at Leyden he has also given a complete exposition of his ideas in their relation to the theory of selection and of Weismannism; against the latter Eimer takes a most decided stand (see 'Extract from Comte Rendu des Séances du 3me Congrès international de Zoologie, Leyde, 16–21 Sept., 1895). This lecture includes the programme of Eimer's most recent exposition of 'Orthogenesis' embodied in a work that is just about to appear.

Countess Dr. M. von Linden.
Zoological Institute, Halle.

The Countess von Linden's article presents the arguments in favor of Eimer's theory. A reply seems unnecessary and others will judge of the value of the theory. Eimer's earlier papers I knew; whether I understood them or not I cannot decide. All of Eimer's evidence is essentially that he *asserts* that of a group of living species a certain form or certain forms are ancestral types. If one denies that assertion Eimer cannot *prove* that it is correct, but unless he *proves* it his deductions remain hypotheses. The reader is asked to consider whether Countess von Linden offers proof that a certain species in any given case is the ancestral race.

For the sake of a fair discussion I am glad that the preceding communication from Professor Eimer's assistant appears in Science.

Charles S. Minot.

*PROGRESS OF PROFESSOR KITASATO'S INSTITUTE FOR INFECTIOUS DISEASES AT TOKIO.**

Among the changes in the general condition of Japan, due to the introduction of Western civilization, one of the most noteworthy is the entire revolution in the system of medicine; the old Chino-Japanese school has been superseded by the scientific system of the West, and the striking feature of the new medicine in this empire is the ascendency of the bacteriological element. The center of this movement is seated at the 'Institute for Infectious Diseases,' directed by Dr. Kitasato.

To Mr. Fukusawa belongs the credit of having initiated the introduction of this branch of medical science into this country by building, at his own expense, a laboratory for Dr. Kitasato, upon the latter's return from Germany in 1892. I do not mean to ignore what has been done at the University and elsewhere; I only emphasize the great impetus that the study of the micro-organisms has enjoyed since the establishment of the above mentioned laboratory. Subsequently the Institute became connected with the 'Sanitary Society of Japan.' The ensuing year the Imperial Diet

* This article was prepared at the request of the Editors. Dr. Nakagawa is a graduate of Princeton University.

granted the sum of 20,000 yens ($10,000) for the building and equipment of the Institute, and also yearly the subsidy of 15,000 yens, which was to be continued for three years. At the expiration of the term the same subsidy has been renewed for the same number of years. Thus the Institute has no relation with the Imperial University of Tokio and is directly under the patronage of the Minister of the Interior.

The work of the Institute is divided between the scientific and clinical departments; the scientific department is subdivided into the laboratory for original researches and the didactic branch for the postgraduate course in practical bacteriology.

(a) *Laboratories for Original Researches.*

It is here that Dr. Kitasato continues his investigations, and I take this opportunity to recapitulate some of the more important reports issued from his laboratory.

(1) *Tsutsugamushi.*—This malady, which is endemic in certain parts of this country, presenting the clinical feature resembling that of the typho-malarial fever, has been ascertained to be the pathological condition due to the parasitic invasion of the red blood corpuscles analogous to that which obtains in malaria. Moreover, the plasmodia of tsutsugamushi is described as being morphologically very nearly related to that found in malaria, but differing from the latter parasites in this important respect: viz., that the tsutsugamushi parasites are refractory to all the staining procedure now in use.

(2) *Bacillus Pestis.*—The discovery of the plague bacilli is too well known to need mentioning in this connection were it not for the fact that it seems to be utterly unknown to the world that the bacilli claimed to be the specific germ of the plague by Dr. Yersin is absolutely different from that described by Dr. Kitasato. Dr. Kitasato's bacilli are almost exactly like those of chicken cholera (in shape), *i. e.*, each bacillus presents the appearance of a pair of diplococci, and is, as a rule, considerably smaller than Dr. Yersin's bacillus. Kitasato's bacilli can be stained according to Gram's methode, while the other is decolorized by the regular procedure. Kitasato's bacillus is surrounded by a distinct capsule which is wanting with Yersin's. Moreover, Kitasato's bacilli are motile, but Yersin's bacilli are not. There are thus at present two distinct bacilli held to be the ætiological factor of the disease in question. It is to be hoped that the members of the commission sent out to Bombay will help to clear up the confusion.

(3) *Anti-diphtheritic serum.*—The preparation of the serum has been carried on in this Institute previous and up to the opening of the Imperial Government Serum Institute, in June, 1896. I might mention in this connection that Dr. Kitasato is the chief advisor of the Serum Institute.

(4) *Anti-cholera serum.*—I have had occasion elsewhere to make a brief report of Kitasato's work on this subject (*Brit. Med. Jour.*, July, 1896). I shall only mention here that the result was in so far encouraging that it justifies making further trials of this remedy in the future epidemics. Neither shall I enter into detail concerning the experimental part of the work in which Dr. Kitasato seeks to prove the anti-toxic property of the cholera-serum; suffice it to say that the conclusion he has reached is at variance with that of the Berlin school.

(5) *Lepra.*—Dr. Kitasato has been engaged in the most thoroughgoing investigation into the treatment of leprosy. It is reported that he is in possession of the remedy which goes under the name of 'Leprine,' though I am unable to say that its preparation is, in any way, analogous to that of tuberculine, as its name seems to suggest. It is expected that Dr. Kitasato will favor the world by publishing his full report in the near future.

(6) Investigations concerning the typhoid and erysipelas serums, as well as various other researches in all the fields of micro-biology, are being pursued by the Professor himself, as also by the assistants under his supervision. There are 6 assistants and nearly 10 'extra-ordentliche' assistants.

The studio for micro-photography has recently been built and is equipped with Zeiss's complete apparatus.

The library, though in its infancy, contains most of the works on infectious diseases, bacteriology and hygiene, and is supplied with the medical periodicals in the English, French, German, Italian and Japanese languages. I take this opportunity of acknowledging the receipt of the following official publications from America: U. S. Department of Agriculture, Bureau of Animal Industry; Bulletins U. S. Treasury Department, Marine Hospital Service, Health Reports, etc.; City of Brooklyn, Department of Health, Annual Report. We should be glad to receive more of the American publications.

(b) *Practical Course in Bacteriology.*

The utility of the knowledge of micro-organisms being admitted, it was deemed desirable to give a practical course of bacteriology for the benefits of the licentiates in medicine. The first course was given in March, 1894. The course is of three months' duration and is conducted by Professor Kitasato, who gives a series of lectures on the pathogenic bacteria. The assistants take their turn and serve as demonstrators. The laboratory for instruction accommodates 50 students and is provided with all necessary appliances. Over 200 physicians have gone through the course. It is with great pleasure that we mention in this connection that the American naval surgeon and an English naval surgeon have availed themselves of the facilities of the Institute and have pursued their investigations for a considerable length of time.

(II.) THE CLINICAL DEPARTMENT.

The wards in all are capable of holding 50 patients. The admission is limited to cases of contagious diseases (except cholera and smallpox). Diphtheria, tuberculosis, typhoid, tetanus and relapsing fever are the principal maladies on the list. I may mention in this connection that 180 cases of leprosy have been treated in the out-patient department with the injection of 'Leprine,' and 4 cases of complete recovery, beside several cases of improvement, have been reported. The diphtheria statistics show a mortality of 9,44%.

A. NAKAGAWA.

INSTITUTE FOR INFECTIOUS DISEASES, TOKIO.

NINTH ANNUAL MEETING OF THE ASSOCIATION OF ECONOMIC ENTOMOLOGISTS, DETROIT, MICH., AUG. 12–13, 1897.

THE Association met in room 212, Central High School building, immediately following the adjournment of Section F. Thirteen active members were present, together with many visitors, prominent among the latter being Dr. C. A. Dohrn, Professor E. B. Poulton and Dr. C. S. Minot. The attendance for the four sessions averaged about 35. The address of the retiring President, Professor F. M. Webster, Wooster, Ohio, treated of 'The Present and the Future of Applied Economic Entomology in the United States,' and contained, among other very interesting features, an admirable tribute to the value of the systematist and a somewhat caustic criticism of the 'species maker,' helpful suggestions for the experiment station worker, and a very frank discussion of the unfortunate results which attend the attempts sometimes made to combine politics and science.

The following were elected to active membership: G. B. King, Lawrence, Mass.; Gerald McCarthy, Raleigh, N. C.; E. P. Felt, Albany, N. Y.; A. F. Burgess, Mal-

den, Mass.; W. B. Barrows, Agricultural College, Michigan; R. H. Pettit, Agricultural College, Michigan; W. S. Blatchley, Indianapolis, Ind.

The following were elected foreign members; Claude Fuller, Richard Helm, both of Perth, West Australia. These additions increase the members of this Association to 93 active and 31 foreign members.

The following papers were read and discussed: 'Additional Observations on the Parasites of *Orgyia leucostigma*;' 'Temperature Effects as Affecting Received Ideas on the Hibernation of Injurious Insects;' 'A Valuable Coccid;' 'Notes on the Common House Fly,' L. O. Howard; 'Notes on Certain Species of Coleoptera that attack Useful Plants' (abstract), F. H. Chittenden; 'An Experience with Paris Green,' T. D. A. Cockerell; 'Insects of the Year,' E. A. Onerod;' 'A Fungus Disease of the San Jose Scale,' P. H. Rolfs; 'The San Jose Scale in Michigan;' 'A Malodorous Carabid, *Nomius pygmaeus*,' W. B. Barrows; 'A Study of Lepidopterous Insects at Light and at Sugar;' 'Vernacular Names of Insects,' C. P. Gillette; 'A Study of the Possible Origin and Distribution of the Chinch Bug,' F. M. Webster; 'Notes on Cape of Good Hope Insects,' C. P. Lounsbury; 'The Giant Cactus and Its Fauna,' H. G. Hubbard; 'Insects of the Year in Ohio,' F. M. Webster–C. W. Mally; 'On the Preparation and Use of Arsenate of Lead,' A. H. Kirkland. A number of papers, the authors of which were not present, were read by title and will be included, probably, in the published proceedings of the Association. Among these papers were the following: 'Notes on Insecticides,' 'The Peach Twig Borer, *Anasia lineatella*,' C. L. Marlatt; *Ledra perdita* vs. *Centruchus liebeckii*,' F. W. Goding; 'Notes sur les Insectes Nuisibles observés en Algerie et en Tunisie pendant l'année 1896–97,' 'Notes sur les Insectes Nuisibles observés en France,' Paul Marchal; 'Notes on Injurious Insects of Norway and Sweden,' W. M. Schoyen.

Several resolutions were passed, among which were (1) a resolution requesting the publication of the proceedings as a bulletin of the Division of Entomology, U. S. Dept. of Agriculture and (2) expressing familiarity with the efforts of the State of Massachusetts to exterminate the gypsy moth and commending the results already accomplished.

The election of officers resulted as follows: President, Herbert Osborn, Ames, Iowa; First Vice-President, Lawrence Bruner, Lincoln, Neb.; Second Vice-President, C. P. Gillette, Ft. Collins, Colo.; Secretary–Treasurer, C. L. Marlatt, Washington, D. C.

The next meeting of the Association will be held at Boston, Mass., August 19–20, 1898.

A. H Kirkland,
Secretary pro tem.

CURRENT NOTES ON ANTHROPOLOGY.

THE ANCIENT SLAVONIC TYPE.

There prevails considerable uncertainty as to the appearance of the ancient Slavs. Professor Lubor Niederle, of Prague, however, in a recent work, and also in *Globus*, No. 24, advances what seems sufficient reasons to pronounce them to have been blonde and dolichocephalic. He quotes the earliest authentic references in classical authorities, all of which refer to the fair complexion and reddish blonde (ξανθός) hue of the Slavic peoples. In these respects the descriptions are the same as of the early Goths.

It is true that at present, and also in many interments of ancient dates, brachycephalic skulls are found in considerable numbers; and persons with dark complexions and dark hair are numerous in Slavic countries. Professor Niederle explains this change of type by two agencies, intermixture with other stocks, and by civilization.

About the latter he writes: "We cannot demonstrate the connection, but there is a striking parallelism between advancing civilization and the gradual increase of the skull in width." This is an interesting statement, and it is to be hoped that Professor Niederle will make it the subject of a special study in the future.

THE LANGUAGE OF THE MAMS.

THE Mams lived in the northwestern part of Guatemala and enjoyed an advanced indigenous civilization. Their capital was Zakeleu, the White Land, meaning the place of culture; for in all the Maya dialects white is a metaphorical expression for civilized conditions. By some the Mams have been held to be the earliest of the Mayas to become sedentary and city builders. Their ancient native name was Zaklohpakap, the White Cultivators.

A vocabulary of their tongue was printed by Father Reynoso, at Mexico, in 1644, but is now so scarce that it is inaccessible to students. The Comte de Charencey has, therefore, conferred a favor on Americanists by republishing it in the *Actes de la Société Philologique*, Tome XXV. It contains nearly three thousand words, and offers ample material for comparisons with the other dialects of the stock. It is closely akin to the Quiche, and is still spoken in a number of villages. The volume may be had from C. Klincksieck, 11 Rue de Lille, Paris.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

IN 1887 Professor Chroustchoff announced the discovery of a new element in the monazite sand of North Carolina, to which he gave the name 'russium.' This discovery has not been confirmed by any other chemist, but, induced by the supposed discovery of 'lucium,' Professor Chroustchoff has again gone over his work, publishing a short report in the *Journal* of the Russian Chemical Society. According to *Nature* he has from 25 kilos of rare earths extracted 35 grams of russium. It has an atomic weight of 70.5 and its spectrum is characterized by a group of green and violet lines. He also claims to have resolved cerium into five components, differing in physical properties, and having atomic weights respectively of 138, 140, 142, 146 and 156.5. He also finds, in addition to Auer's neodymium and praseodymium, a third new constituent of didymium to which he gives the name glaukodymium. A detailed account of his work is promised at an early date.

IN the last *Berichte*, W. Hentschel gives an account of further investigations on the chloride of nitrogen, in which he finds the compound normally formed to have the formula NCl_3, confirming the work of Gattermann and of Balard. He also finds that this compound can take up more chlorin until its composition seems to be NCl_5, but this is really a solution of chlorin in the chloride of nitrogen. His method of forming this exceedingly explosive and dangerous compound is to bring together solutions of ammonium chlorid and sodium hypochlorite, and dissolve the chlorid of nitrogen formed, which partly separates out and partly remains in solution, in benzine.

IN the *Pharm. J. Trans.*, C. H. J. Warden describes the method used in the Calcutta Medical Depôt for the production of a pure silver nitrate from coin silver. The silver used contains copper and is dissolved in nitric acid and a portion of the silver nitrate crystallized out in the usual way. As soon as the mother liquor is so concentrated that the silver nitrate crystallizing out is contaminated with copper it is evaporated to dryness, finely powdered and placed in a glass funnel stopped by an asbestos plug. It is then washed with pure concentrated

nitric acid until perfectly white. The copper nitrate is very easily soluble in the nitric acid, while the silver nitrate is almost wholly insoluble. Any trace of silver dissolved by the nitric acid can be recovered by treating with salt. This is by far the simplest method proposed for obtaining pure silver salts from coin or plate, and deserves trial in our laboratories.

H. TRYLLER describes in the *Berichte* a new turbine for laboratory use, which lays claim to the advantages of steadiness, noiselessness and economy of water. To the axle is attached a circular piece of wire gauze, rotating in a thin cylindrical space. The jet of water strikes the edge of the gauze at a tangent and escapes by a pipe in the center opposite the end of the axle. A speed of four thousand revolutions is easily attained. The turbine is to be manufactured by M. Koehler and Martini, of Berlin.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE meeting of the British Association at Toronto has proceeded in accordance with the program. The members in attendance, about 1,200 in all, have been received with great hospitality, and many important papers have been given before the sections. The meeting is still in progress as we go to press, and we shall defer an account of the proceedings until next week.

THE British Medical Association will meet in Edinburgh in 1898, under the presidency of Professor T. Grainger Stewart.

ACCORDING to the latest lists about 5,000 members had expressed their intention of attending the 12th International Medical Congress meeting this month in Moscow; about half of the number are Russians, 800 are from Germany, 600 from Austria, 500 from France, 250 from England and from Italy, and 100 from America.

THE sixty-ninth meeting of German Men of Science and Physicians will, as we have already noted, be held at Brunswick from the 20th to the 25th of September. The social arrangements begin on the preceding day with a reception, a banquet and an exhibition of sports. The first general meeting opens on the 20th with the reports of officers, followed by two addresses, one by Professor Richard Meyer, of Brunswick, on the relations between chemical research and technical chemistry; the other by Professor Waldeyer, of Berlin, on fertilization and inheritance. At the second general session Professor Orth, of Göttingen, will speak on medical instruction and the practice of medicine, and Dr. Hermann Meyer, of Leipzig, on central Brazil. Several joint meetings of the sections have been arranged, one of special interest being a discussion of scientific photography in its applications to the natural sciences and to medicine.

THE Scientific Society of Argentina, says *Nature*, is organizing a Congreso Cientifico Latino Americano, to be held at Buenos Ayres in April next, in commemoration of the twenty-fifth anniversary of its foundation. The Congress will be under the patronage of the President of the Argentine Republic and the Ministers of Justice, Foreign Affairs, and Public Instruction. There will be seven sections, dealing respectively with exact sciences (pure and applied mathematics, astronomy, geodesy and topography), engineering, physics and chemistry, natural science, medical sciences (including hygiene and climatology), anthropology and sociology.

WE noticed sometime since the appointment of a committee to investigate the condition of the Coast and Geodetic Survey. This committee has now presented a report which will not be made public. The Washington *Star*, however, states that it is practically decided that a successor to the present Director of the Survey will be appointed, and that the selection will be made without reference to political considerations and on the grounds of scientific standing.

PROFESSOR C. B. HOWES, writing Dr. Thurston to inform him of the condition of the work of the Huxley Memorial Committee, states that the statue is now in progress, in the hands of Mr. Ford, the sculptor, and promises to be most excellent. It is to be a seated figure in a gown,

to be placed at the bottom of the steps in the Hall of the Natural History Museum leading up to the statue of Darwin. It is in white marble. The design for a medal for the Royal College of Science is thought admirable, and the medal is in preparation. It is further possible, if subscriptions continue, that a medal may be instituted, open to the world of biologists, and awarded by the Royal Society. The Messrs. Macmillan, as a memorial, also, are publishing a fine edition of Huxley's scientific papers; the first volume being now well in hand. There are on the list many subscriptions from America and it is not too late for others to be sent.

THE monument to Darwin to which we have several times referred was unveiled on August 10th. It is in his native town of Shrewsbury and in front of the school which for nine years he attended. The monument, the work of Mr. Horace Montford, represents Darwin seated in a chair holding some manuscripts from which his face is turned as if deep in thought, while at the foot are a number of volumes representing his finished works.

DR. VICTOR MEYER, professor of chemistry at the University of Heidelberg, died at Heidelberg of apoplexy on August 8th, aged 49 years. Meyer filled chairs of chemistry at Stüttgart, Zurich and Göttingen and finally succeeded Bunsen at Heidelberg in 1889. His work was in organic chemistry, more especially relating to the nitro-compounds and the vapor density of volatile compounds.

WE regret also to record the deaths of M. Quantin, assistant in the taxidermic laboratory of the Paris Museum of Natural History, and of Dr. W. Petzold, a writer on geography and astronomy.

WE learn from *Cosmos* that the new buildings of the Paris Museum of Natural History have not been completed as soon as was expected, the work of construction having been stopped for three months owing to the delay in voting funds for its completion. Work has, however, now been resumed and it is hoped that the galleries will be open to the public by the beginning of next year. The lower floor contains the collections of comparative anatomy which are being arranged under the direction of MM. Filhol and Jarvis. The collections of anthropology and paleontology are being put in order on the upper floor. The collections have hitherto been badly arranged in crowded quarters, but will now be exhibited to great advantage. New catalogues giving full details are also being prepared.

AN exhibition has been opened in the zoological galleries of the Paris Museum of Natural History containing the collections in natural history made by M. Chaffanjon on his expedition to Siberia and Central Asia.

AN exhibition of navigation instruments was opened in London on August 5th, intended especially to illustrate the progress that has been made in the art of navigation during the Queen's reign. There are in all about two hundred exhibits including a sextant by Bird, said to have been used by Captain Cook, lent by the Royal Astronomical Society, Lord Kelvin's deflector for adjusting the compass, his sounding machine and other instruments of historical or scientific interest.

WE learn from *Die Natur* that the committee for the introduction of the produce of German colonies held its general meeting in Hamburg, recently. The committee has founded a journal called *Der Tropenpflanzer*, and has established in Berlin a permanent exhibition of colonial imports. The committee offers prizes for the development in the African colonies of new resources, such as the making of wine, the cultivation of coca and quinine, the production of gum arabic, etc.

THE Hungarian government has completed the necessary arrangements for the construction, without delay, of a subway beneath the Danube at Budapest on the same principle as that of the new Blackwall tunnel under the Thames in London.

A TELEGRAM from San Francisco states that Commissioner-General Herman, of the United States Land office, has arrived there for the purpose of conferring with Professor Hilgard and other members of the State Forestry Commission upon the subject of the forest reserves, of which about 6,000,000 acres are located in California.

There has been established in Switzerland a weather bureau. A dispatch is sent each evening from Zurich giving the weather probabilities for the next twenty-four hours. The predictions are based on data received from the principal meteorological stations of Europe combined with experience of local conditions. The dispatch is further distributed by telephone to those communes prepared to subscribe 10 frs. per month for the service.

The Royal 'Institut für Pflanzen Physiologie and Pflanzen Schutz,' in Berlin, offers to give, without charge, information and advice regarding diseases and injuries of cultivated plants. It is also prepared to send agents to examine the plants without charge beyond the railway ticket which, in certain cases, will also be paid by the Institute.

An International Conference of Legal Medicine convened at Brussels on August 2d. It was welcomed by the Belgian Minister of Justice, and Dr. Veleminckx, the Honorary President of Committee of Organization, gave an account of preceding conferences. A number of topics were discussed concerning the relations of medicine and law—among them the treatment of insane criminals, regarding which a series of recommendations was passed by the Congress.

The Eighth Annual Congress of French-speaking Neurologists met at Toulouse on August 2d. Addresses were made by Dr. Ritti and Dr. Labéda, on Esquirol, who was born at Toulouse, and Pinel, who was born near by, as the inauguration of memorials to be erected in their memory. Pinel and Esquirol, as is well known, were leaders in the reforms in the treatment of the insane. Before their time it was usual to treat the insane as intermediate between criminals and wild animals. They first showed that insanity is a disease, and in many cases a curable disease.

We noted last week the loss, in the shipwreck of the *City of Mexico*, of the collections and apparatus of the zoological expedition sent by Columbia University to Alaska. Word has just been received by mail that the party lost all the results of their season's work. They left Sitka in the *City of Mexico*, of the Alaska S. S. Co., on August 4th, taking the outside passage. At 4:20 a. m. on the 5th, in a heavy fog, the vessel attempted to enter Queen Charlotte Sound, through Dixon's Channel, and ran upon a reef known as Devil's Rock, sinking in two hours. The crew and passengers were transferred to life boats and after seventeen hours of exposure reached the Indian village at 11 p. m., where they were hospitably cared for until the arrival of the *City of Topeka*, three days later. The Columbia party lost all their collections, drawings, notes and apparatus, excepting three microscopes. They will reëstablish the old station at Port Townsend, Puget Sound, for the remainder of the season.

M. Robert Wurtz, professor at the Paris School of Medicine, one of the leading French bacteriologists, has been chosen for a mission in Abyssinia. He will go to Adis Abeba, where, after having organized a department of vaccination, he will study the rinderpest and similar infectious maladies.

The steamer *Belgica*, with the Gerlache Antarctic expedition on board, sailed from Brussels on August 16th. The Belgian Chamber of Representatives has made an additional appropriation of 60,000 frs. for the expedition.

A message has been received from Turnavick, on the coast of Labrador, dated July 28th, stating that the steamer Hope, with Lieutenant R. E. Peary's expedition abroad, had touched there that day and sailed again on its way to Greenland. All on board were well.

A serious epidemic of small-pox is feared at Montreal. The city has been divided into twenty-four districts, and there will be a house-to-house vaccination.

Dr. Marten, chief of Dr. Roux's laboratory of the Pasteur Institute, has been awarded an honorary gold medal by the French government for his work in epidemiology.

Señor Canovas, by his will, has left to the National Library, at Madrid, a collection of 30,000 books, many of which are very rare.

A building for a free library and historical society, to cost $20,000, has been given by Mr. Spalding, of Chicago, to Athens, Pa., his native town.

An explosion occurred recently in a laboratory at Saint Michael-de-Maurienne, where carbide of calcium was being manufactured. The building was destroyed and one workman was killed and three others were seriously injured.

The unpublished journals of the great naturalist Audubon, written in French, are being translated for publication in English by his granddaughter, Miss Maria Audubon.

Ginn & Co. announce that they will publish at once 'Stories of Insect Life,' by Professor Clarence M. Weed, of the New Hampshire College of Agriculture and Mechanical Arts. The book is designed to give information to the child regarding the lives of the insects, and to stimulate pupils to fuller observation of insects out-of-doors.

The trustees of the Boston Public Library have authorized the publication, in their bulletins, of an exhaustive 'Bibliography on the Anthropology and Ethnology of Europe,' prepared by Professor William Z. Ripley, of the Massachussetts Institute of Technology, lecturer in anthropo-geography at Columbia University. This list of references will include about 1,500 titles, taken in every instance from the original sources. It embodies the raw materials of the papers on the Racial Geography of Europe now appearing in successive numbers of the *Popular Science Monthly*, afterward to be published in book form. Every precaution has been taken to insure completeness and accuracy; most of the living authorities will have corrected and supplemented the lists of their own works in proof. The bibliographical systems of Minot and Wilson will be employed, with a complete subject index. A special feature will be the reference to original maps, whether linguistic, somatological or ethnographical. It is worthy of note that practically all of the titles in this recent field of investigation are upon the shelves of the Boston Library, proof positive of the possibilities for research from original sources which are now afforded by our great American collections.

We are glad to welcome a new edition of the 'Dynamic Sociology,' of Professor Lester F. Ward, published by the Appletons. The first edition, issued in 1883, was very fully reviewed in four articles included in the second volume of this Journal, and no material changes have been made in the present edition. There is much to be said for not attempting to recast a work that represents a given epoch in the history of a new science. The further development of the author's views on psychology have been given expression in a separate volume (the 'Psychic Factors of Civilization,' 1893), and this is a better plan than re-writing a standard book. An interesting preface to this edition of the 'Dynamic Sociology' notes that fourteen years ago, when the work was first published, the word *sociology* was used but rarely; there were but few books on the science, no journals, and no university chairs. Now all is changed; the word is on the lips of everyone, and the science, if given as wide a range as Professor Ward's book, bids fair, as he says, to become the leading science of the twentieth century. The preface gives some account of the suppression of the Russian translation of the book, which was widely commented on in the daily papers several years ago. The suggestion is made that the title suggested socialism and dynamite to the Council of Ministers, a very dangerous combination from their point of view. A Polish translation appears also to have been suppressed, but four Russian translations of the 'Psychic Factors of Civilization' have been made.

Professor Bailey's 'Principles of Fruit Growing' (The Macmillan Co) is both practical and scientific. As all that the author writes —and it is not little—the book is worth reading, both by the practical gardener and by the student. After an introduction covering the kinds of fruits, the geography of fruit growing and its methods, chapters are devoted to location and climate, the tillage of fruit lands, their fertilization, their planting and their care, followed by chapters on disease and insects, and on harvesting and marketing. Professor Bailey makes many acute remarks, as when he calls spraying 'insurance' and gives as one of its uses 'waking up the horticulturist.' This volume is the fifth in this 'Rural Science Series,' edited by the author of this volume, which has fulfilled the promise of the publishers to be 'readable, simple, clear-cut, practical, up-to-date, and thoroughly scientific and reliable.'

WE have received from W. B. Saunders, Philadelphia, a bulky volume by Drs. George M. Gould and Walter L. Pyle, entitled "Anomalies and Curiosities of Medicine: Being an encyclopedic collection of rare and extraordinary cases, and of the most striking instances of abnormality in all branches of medicine and surgery, derived from an exhaustive research of medical literature from its origin to the present day, abstracted, classified, annotated and indexed." We should scarcely suppose that the compilation of this volume would repay the labors of the compilers and the costs of publication. A miscellany like this can scarcely be regarded as a contribution, such as Geoffroy Saint-Hilaire made, toward an explanation of the formation of monstrosities in its relation to zoological theory. Still the study of variations is of the utmost importance for zoology, and extreme cases of human abnormality may prove useful to the student of the theory of evolution. The cases given in the work are treated critically, full references being given and a fairly conservative attitude being adopted. But one modern instance is worth more than many old saws, and it is rather a contribution to folk-lore than to medicine to relate stories, qualified as incredible, such as that of Countess Margaret and her 365 infants.

THE fifty-eighth anniversary meeting of the Fellows of the Royal Botanic Society was held on August 10th, in the Society's gardens at Regent's Park, Mr. C. Brinsley Marlay presiding. According to the report in the London *Times* six new Fellows were elected and eleven candidates were nominated for election at the next meeting after the vacation. The annual report of the Council to the Fellows stated, among other things, that tentative arrangements had recently been made for taking visitors round the gardens by members of the staff to point out objects of special interest. Free tickets had been granted during the year to about 800 students. About 50,000 specimens of plants had been given for educational purposes. The Council had decided to open a school of practical gardening and to hold examinations and grant certificates for gardeners. The new school had already been officially recognized by the Technical Education Board, which was sending pupils to attend its classes and had voted an annual grant of £100 to the Botanic Society in aid of the scheme. The number of Fellows on the books had risen from 1,700 in 1887 to 2,000 in 1897. The report having been presented, a discussion followed in which Sir Blundell Maple, M. P., proposed that the Society should build in the gardens a club-house to which the Fellows could have access. He volunteered to lend the Society a sum of £3,000 for this purpose, the money to be repaid by easy instalments. He anticipated that such a club would be a large source of income to the Society, and he added that if it should eventually prove to be a loss the loss should be his. Eventually the report was adopted unanimously. The chairman announced that the promise of a new lease of the gardens, to commence on the termination of the present one, had been definitely given by her Majesty's Commissioners of Woods and Forests for a fresh term of 31 years, and that the Society's outlook was now most promising.

THE research scholars of the British Medical Association (the scholarships being of the value of $750 each) have handed in their reports. Dr. J. B. Leathes has been engaged in a research into the nature of mucin-like proteids contained in ovarian cysts. Dr. J. S. R. Russell has been studying the tracts of the medulla oblongata and the cervical nerves. Dr. Swale Vincent has been studying the physiology of the suprarenal capsules.

ACCORDING to the *British Medical Journal* the new State Institute for researches with Röntgen rays, or 'actinography' (as the new term runs) has been opened under the direction of Professor Grunmach. It is close to the Charité Hospital and its clinical institutions, and has every convenience for the transport of severe cases. Needless to say, the Institute is furnished with all the newest appliances; it contains a laboratory, a lecture theatre, photographic rooms, and a room where the patients are examined according to the usual methods before being subjected to the X-rays. In the first week after the opening of the new Institute,

two of the rare cases of inversion of the viscera were sent from the Charité, actinography revealing the inverted displacement of the organs, their size and motions, with the greatest distinctness.

PROFESSOR GOTCH, Waynflete professor of physiology at Oxford, in his annual report states that the following research work has been in progress during the present year: (1) The Professor and Mr. G. J. Burch. Upon the Electromotive properties of Malapterurus electricus, being a continuation of previous work on the subject. (2) The Professor. On the Tendon Effect and on the Influence of Temperature upon Excitability and Conductivity. (3) The Regius Professor of Medicine. On Muscular Contraction. (4) Dr. J. S. Haldane and Professor Lorrain Smith. On the Oxygen Tension of Arterial Blood, the Detection of Carbonic Oxide in Air and Blood, the Action of Nitrites upon Blood, etc. (5) Dr. Mann. On the Changes in Nerve Cells Associated with their Activity. (6) Mr. W. H. Vernon. On the Respiratory changes of Cold-blooded Animals. (7) Miss Huie. On the Changes in the Cells of Drosera. (8) Professor Sherrington and Mr. J. S. Macdonald. On the Neuro-muscular Mechanism of Respiration. (9) Mr. Buddicom. On the Effect of Ether and other Gases upon Nerve Excitability, etc. (10) Mr. W. E. Stainer. On the peptic properties of Pitcher-plant liquid.

UNIVERSITY AND EDUCATIONAL NEWS.

THE University of Berlin has set an example in maintaining academic freedom by electing as Rector for the coming year Professor Gustav Schmoller, who is supposed to have incurred the enmity of the Emperor by the character of his lectures on political economy.

THE Paris correspondent of the London *Times* states that under the law of July 10, 1896, decrees have been issued for the government of universities. Each university is to have a council consisting of the rector, the heads of faculties, and two delegates of each faculty elected triennially by the professors. The council, subject in certain cases to the approval of the supreme education council, will have control over the teaching, discipline, and property of the university. It will, however, have merely a consultative voice on the finances, and on the creation, abolition or transformation of professorships, for the State will continue to pay the stipends. The maintenance of buildings, on the other hand, will fall on the university, and must be defrayed from students' fees or from endowments. The State takes the fees for examinations and State diplomas, but all other fees go to the university treasury. It will, therefore, be to the interest of each university to attract as many students as possible. The receipts of Paris University are estimated at 600,000f. and of Lyons at 130,000f., but Besançon and Clermont have at present only 700f. or 800f., and will obviously have to solicit subsidies either from the State or from local bodies. Failing this, the smaller universities are likely to succumb. One of the features of the new system is that a student will, as in Germany, be able to migrate from one university to another without lengthening his studies or delaying his degree.

THE Swiss government has for several years offered *courses de vacance* or university extension courses at Lausanne and Geneva, which have been attended by numbers of American, English and other foreign students. The Department of Public Instruction has now decided to supplement the courses given by the Faculty of Letters by adding to the program scientific and historical excursions, with lectures given gratuitously by university professors.

AT the meeting of the London County Council on July 20th the Technical Educational Board presented their report for the preceding quarter. It stated that arrangements had been made with King's College and University College for evening courses of instruction, to be given to persons who are engaged during the day, in civil engineering, mechanical engineering, architecture, natural philosophy, pure mathematics, electrical engineering, magnetic and electric currents, the strength of materials, the principles of practical physiology, experimental physics, and the teaching of mathematics. Arrangements had also been made for a Saturday morning course to teachers to be held at Bedford College. In the 'teachers' courses the aim would be to explain the best educational methods of teaching the respective

subjects to their pupils and not to prepare the teachers to pass examinations. The payments made by the Board during the quarter amounted to about $100,000.

DEGREES of a 'Chicago National University' have been for sale in London. The *Times* states that it has "received a telegram from Mr. Francis Harkins, the Chancellor of the Chicago National University, stating that that university repudiates agents who offer degrees on payment of a guinea." There are five hundred colleges and universities in the United States entitled to confer degrees, but the 'Chicago National University' is not one of them.

MISS MARTHA VEEDER has been appointed professor of mathematics at Huguenot College, Cape Colony.

M. JUMELLE has been made assistant professor of botany, and M. Beaulard assistant professor of physics in the faculty of sciences of Grenoble, and M. Brunhes has been made professor of physics in the faculty of sciences of Dijon.

DISCUSSION AND CORRESPONDENCE.

METEOROLOGICAL OBSERVATIONS DURING AN ATLANTIC VOYAGE.

TO THE EDITOR OF SCIENCE: A few notes of meteorological interest, made during a recent voyage from New York to Rio de Janeiro, may not be unwelcome to the readers of SCIENCE. The trip itself is one which cannot fail to interest anyone who has a knowledge of meteorology, for the steamer route crosses several of the great wind and calm belts of the world, and the characteristic features of each belt are brought into striking contrast as the ship passes from prevailing westerlies into 'horse latitudes,' and then successively through N. E. trades, 'doldrums' and S. E. trades, the voyage ending in the 'horse latitude' belt of the southern hemisphere. A teacher of meteorology who has the good fortune to take this voyage must constantly feel how grand an opportunity the trip would give him to teach the great facts of this science to a class of students, if he could only take his class with him. It would indeed be field-work, if such an expression may be used, on a magnificent scale.

The formation of cumulus clouds over islands has been noted by many observers in different parts of the world, but is always of interest. On June 8th, early in the afternoon, the ship was some distance to the eastward of Bermuda. The sky, except in the west, was covered with strato-cumulus clouds, and the wind was light from S. S. W. On the western horizon the sky was lighter, and the sun was shining on the low clouds. In this direction, which was that in which Bermuda lay, could be seen a considerable number of cumulus clouds, radiating from below the western horizon, and moving across the sky to the N. E. These were evidently coming from the island, for in no other part of the sky were there any other cumulus clouds to be seen. The cumuli diminished rapidly in size as they increased their distance from their place of origin, and they were lost sight of as the ship's course took her farther away from the island. Another observation of cumulus clouds formed over land was made on the morning of June 23d, when about 10 miles off shore north of Bahia. There was a splendid development of cumuli over the land, the shore-line to the north and south being outlined in the sky by the clouds, while over the ocean there were only a few scattered trade cumuli.

On June 9th (noon position 29°43′ N., 59°23′ W.), between 3 and 4 p. m., there was a fine opportunity to study the growth and mechanism of an advancing thunderstorm. These storms, as the writer has pointed out in an account of the thunderstorms of New England, advance, when well developed, in a long line (storm-front), but their activity is not the same all along this line. In some places where there is more active convectional ascent the rain and thunder and lightning are more severe, while at other points along the same storm-front there may be no rainfall, and the clouds may even seem to break away. It is these apparent breaks along the storm-front which give rise to the common statement that thunderstorms 'divide' over an observer, when in reality there is no true division. On the day in question the thunderstorm when first noted was a single large cumulo-nimbus cloud to the west, and the heaviest rain could distinctly be

seen falling below those portions of the cloud which showed the most lofty tops. These extra heavy rains were seen falling in three places under the main mass of the cloud, and over each of these places the height of the cloud was noted as being especially great. While watching this cumulo-nimbus it was noticed that to the south of it there were some cumulus clouds developing rapidly into cumulo-nimbus and becoming part of the same cloud as that first observed. In this way the storm-front was seen to be extending itself gradually farther and farther to the south, new cumulus clouds continually developing into cumulo-nimbus and joining themselves to the parent storm-cloud. Thus, in an hour, more or less, a long storm-front was developed, extending with a N. E.-S.W. front across the greater part of the western sky. The movement was to the N. E. Careful observation of the storm-front showed distinctly the centers of extra heavy rainfall and the lighter portions in between these centers. In these lighter portions either no rain or light rain was falling.

At sunset on June 18th, in the S. E. trade (noon position, 0°16′N., 38°47′W.), some observations of degrading cumuli were interesting. The afternoon sky was fairly well covered with trade cumuli, some of the clouds almost reaching the cumulo-nimbus stage. Just after sunset careful observation of these clouds showed them dissolving and toppling over in a very striking manner. The clouds were in shadow, and were clearly outlined against the bright sunset sky behind them. The process of disintegration was of two kinds. In the first the top of the cloud, bending forward in the direction of the prevailing wind, simply toppled over to the northwest, breaking off, so to speak, at the point where it joined the main cloud mass. The upper part, after toppling over, quickly evaporated, and a long line of trade cumulus would thus lose their typical form and become flattened out into a long band, which, in time, also broke up and faded away. In the second kind of disintegration the *shape* of the top of the cloud remained unchanged during the process, the cloud particles simply dissolving as they kept their position with relation to the cloud base. Thus, in a few minutes, only the skeleton of the top of the cloud was left, and this also soon evaporated, leaving, as in the first process, a long flat band of cloud. The two processes were quite distinct, although they were both processes of disintegration. In explanation of these phenomena, it appeared that the second kind of disintegration occurred only when the clouds were large and well developed, *i. e.*, where the supply of water vapor from below was probably still active, and the effect of the faster-moving upper air in blowing forward the top was not so strong in consequence. For this reason, the cloud kept its shape well, dissolving without being toppled over, while in the first case the cloud was probably in a stagnant condition, and its top offered less resistance to being blown over.

In conclusion, a few directions of cloud movement may be of interest, although comment on them is omitted by reason of lack of time at the present writing.

June 10. Lat. 26°58′N., Long. 55°41′W. Cirro-stratus from N. W. June 11. Lat. 23° 45′N., Long. 52°30′W. Cirrus from S. W. June 13. Lat, 16°35′N., Long. 47°34′W. Low fracto-cumulus from E. N. E. (wind direction); alto-cumulus from N. E. June 17. Lat. 3°29′N., Long. 40°44′W. Cirro-cumulus from E.; cumulus from S. E. (wind direction). June 18. On equator. Cirrus and cirro-cumulus from E. by S. June 19. Lat. 2°42′S., Long. 36°43′W. Cirro-stratus from E. by S.

R. DE C. WARD.

BUENOS AYRES, July 14, 1897.

SCIENTIFIC LITERATURE.

Travels in West Africa. By MARY H. KINGSLEY. The Macmillan Co. 1897. 16 plates, 29 illustrations in the text. Pp. xvi. + 743. Cloth $6.50

An interesting book in spite of some defects. It takes Miss Kingsley 120 pages to get settled down to the subject of her 'beloved southwest coast;' and the 400th page is passed before you reach the valuable portion of the book.

There is little, past, present, or even future, in connection with West Africa that does not get a touch from her facile pen. There is however an easy flippancy of manner in the story

which carries you on, in spite of a knowledge that the writer is 'on very thin ice' a great deal of the time. The off-hand way in which some rather serious problems are treated is hardly fair, even if we should agree with the sarcasm of some of her criticisms of isolated cases. For example, much space is devoted to the discussion of the subject of the need of proper training for the natives. And where the mission schools go to work along the lines of tailoring, printing, bookbinding, etc., many of which West Africa is certainly not in the most urgent need of, we should agree that they could employ their time much better upon such subjects as smithwork, carpentering or, best of all, agriculture. Our young lady, however, is never tired of quoting Dr. Nassau, for his great learning on the subject of the blacks, and then pokes fun at his efforts and those of some of his colleagues, forgetting that the seamy side of the garment of civilization as applied to the West Coast is probably just as apparent to them as to her, during her rather picnic-like excursions into these regions.

As an example, "even sewing, washing and ironing are a little ahead of time. When the girl goes back to her husband with her two dresses she will soon be reduced to a single dirty rag, which will answer for dress, sheet, towel and dish cloth, and then think of the envy and jealousy of the other wives, and the state of feeling induced by such style. Washing and ironing become parlor accomplishments when your husband does not wear a shirt, and when household linen is non-existent." One might ask the question, What is the use of trying to do anything?

Some of the writer's conclusions form very interesting reading. One of the new reasons given for polygamy is that the man of the house is liable to 'get enough to eat.' But when, after getting fast on a sand bank, and trying to haul off by fastening a line to the trees on the main bank, and succeeding in pulling away the bank, trees and all, she reaches the conclusion that 'Africa is a rotten Continent,' we cannot help but admire the stoical cheerfulness which is certainly the prime requisite for a good traveller.

One of her 'hints to travellers' is worthy of a wide circulation, namely, to always learn the word or words meaning 'I don't know!' as instances are given where four villages and two rivers have been graced with words bearing this interpretation, which does not tend to geographical clearness. Another feature might be added, drawn from the fact that rivers are sometimes called by one name going up, and by another going down the current.

The really valuable portion of the book is that devoted to the subject of fetichism. Here the inspiration of Dr. Nassau is plainly visible, though there is a great deal of clear insight and common sense used in the interpretation of some of these difficult problems. It is a valuable contribution to our knowledge of the subject.

There are five appendices to the work. The first two are by the authoress upon Trade and Labor on the West Coast and upon Labor. These are followed by a chapter by Dr. Günther describing her collection of fish and reptiles. Appendix IV. is by Mr. Kirby, of the British Museum, on the insects obtained from the Ogowe region. The last is a legend of the origin of the cloth loom.

William Libbey.

Princeton University.

The Microscope and Microscopical Methods. By Simon Henry Gage. Sixth edition. Rewritten, greatly enlarged. Comstock Publishing Company, Ithaca, New York. 1896. Octavo; pp. xii+237; 165 figures, 1 plate.

The appearance of a new edition of Professor Gage's work on 'The Microscope' calls for notice, since the addition of a large number of figures and about 90 pages of new material have made it practically a new book. As stated in the preface, the plan of the work is: 'Actual experiments carried on by the student himself;' and in this respect the book is probably unique in its field, and, it is needless to say, thoroughly in accord with the modern scientific method. In the preparation of the book Professor Gage has drawn upon his long experience and numerous publications on microscopic technique, and in particular subjects has taken pains to consult specialists whose authority would not be questioned and to whom due acknowledg-

ment is made in various places. The extensive scope of the book is well shown by an outline of the various chapters: (1) The microscope and its parts. (2) The manipulation of the same. (3) The interpretation of images. (4) Magnification and measurement. (5) Drawing. (6) Micro-spectroscope and polariscope. (7) Technique of the object. (8) Photo-micrography.

To these are added a copious appendix on methods of testing and on preparing figures for publication, while the whole is terminated by an extensive bibliographical list and by a good index. The bibliography is to be especially commended for its accuracy and completeness. A careful review of its five pages of closely printed type discloses only one omission, though that is rather a striking one, the Zeitschrift für angewandte Mikroskopie.

The book is full of valuable information, not only for the student, but for those of considerable experience in microscopic technique, and the number of good hints which are given is very large. Of course, every man has his own ideas with reference to details of technique, and undoubtedly no one would agree with the exact plan outlined by the author. For instance, some would undoubtedly criticise the statements that balsam mounts should be sealed, as also that collodion is the most generally available imbedding material. Many will find fault with the detail of instruction given for the use of the mathematical tables. These are, however, particulars in which the manual is suited to the course given by Professor Gage, and easily capable of omission by those who use the book with other ideas in mind.

It may be fairly questioned whether the amount of space given to the microscope and its accessories from an optical standpoint is not excessive; as compared with Behrens, Kossel & Schiefferdecker, for instance, the extent of space devoted to this branch of the topic is rather striking. In the latter work about 30 per cent. of the space is devoted to the instrument, while 50 per cent. is spent in the consideration of the preparation of the object. In Professor Gage's book the microscope and its accessories occupy about 80 per cent. of the entire work; and even when one considers that some parts are discussed here more fully in the light of recent development in certain branches of the subject, it is still questionable whether the technique of the object has not been slighted in favor of the technique of the instrument. As the reviewer has pointed out elsewhere, it is undoubtedly by the development in the manipulation of the object that recent years have advanced so far, and it is to this advance that we are indebted for our rapidly growing knowledge with reference to more fundamental phenomena of biological science. Some years ago in his address, 'A Plea for Physiological Histology,' Professor Gage himself emphasized this side of the question. The various methods of reconstruction are, in the opinion of the reviewer, of much greater general importance to the student in every branch of biological science than some of the difficult mathematical discussions of optics which are treated at length in the book, and yet the topic of reconstruction has not even been mentioned. This is all the more striking when one recalls that we are indebted to Mrs. Gage for a most admirable and inexpensive method of reconstruction, and when the various methods have been so largely applied both by her and by the author in their various researches.

The treatment of the microscope as an optical instrument, with its various accessories, is exceedingly complete; so much so that Professor Gage gives us fourteen full pages of cuts of microscopes, in which good, bad and indifferent stands are mixed with rare impartiality. There is no discussion of the principles on which the construction of the various types is based, and no choice expressed with reference to which are the most reliable or would best perform certain sorts of work. The beginner, or even a student of some experience, would sit dazed before this collection of figures in his efforts to decide which he needed. The inclusion of so many cuts was, perhaps, a necessity of the case, seeing that the electrotypes were donated by the manufacturers and it would have been unwise to have slighted any particular firm; and yet it might have helped a little to have discussed briefly the general principles of construction involved.

Among minor defects one might mention a lack of care in type-reading, which shows itself

in the use of both m.m. and mm. several times on the same page, and in the recurrence of various misspelled names. It is certainly amusing to learn that an article can easily be made by a *tin smith.* One notices, also, an occasional slip of the pen, as a result of which figure and text do not always agree. Thus, the mechanical stage, shown in figure 69, does not possess verniers, despite the statement in the description of the cut, and the absence of this feature is undoubtedly a serious defect in the construction of the stage as compared with that of another maker which is shown in the adjacent figure. The excessive number and length of the foot-notes in the book mar the beauty of the page, and many of them might easily have been incorporated in the text. It is further true that the constant use of vulgar fractions, which have no place in a scientific text-book, is another point to be justly criticised. Their employment also is not limited to such as are difficult to translate into decimal figures, but $\frac{1}{10}$, $\frac{5}{100}$ mm., etc., are of constant occurrence.

While it would be manifestly unfair to give an idea of the book based merely on these criticisms of minor details, it is evidently impossible to do more than hint at some of the many advantageous features which it contains. The synopses of the steps in the preparation of paraffin and collodion sections are of exceeding value to any student and will doubtless save much time and many errors. Throughout the book one finds very complete cross references and satisfactory bibliographical notes which will be of constant use to the worker. Every topic is completely and concisely discussed; the order is clear and logical, and one is at a loss to suggest points that have been overlooked.

The chapter on Photo-micrography deserves especial mention. It includes much that cannot be found elsewhere and is altogether the best concise statement of the subject which is accessible. This chapter is worth more than the price of the entire work. Like the rest of the book, it is copiously illustrated; the figures are exceptionally well chosen, and among them are a couple of splendid photo-micrographs from the work of Mrs. Gage, who also drew all the original figures by which the work is illustrated. As a whole, the work is a useful and valuable addition to the manuals accessible to the American teacher and is destined to be widely and generally used.

HENRY BALDWIN WARD.

The Chances of Death and other Studies in Evolution. KARL PEARSON. Edward Arnold, London and New York. Vol. I., pp. ix+388; vol. II., pp. 460. $8.00.

Professor Pearson's essays and lectures fall into three groups. One of these is concerned with the theory of deviations from the mean in its application to vital and social phenomena, another with a criticism of certain popular writers who have exploited science for the benefit of religion and politics, and the third with studies in folk-lore and folk-customs, viewed from the light they cast on the evolution of society. All of the essays are of great contemporary interest, and have to a considerable degree the unity claimed by the author, 'the endeavor to see all phenomena, physical and social, as a connected growth, and describe them as such in the briefest formula possible.'

The essays on variation in this volume, and the series of papers on the mathematical theory of evolution published in the *Transactions and Proceedings* of the Royal Society since 1894, represent a scientific advance of great importance. Modern science pursues two main methods; it is either quantitative or genetic. The exact sciences have found in measurement a method of description so efficient, economical and universal that it must be regarded as the goal of those sciences in which description is only qualitative. The genetic method has, however, since the publication of the 'Origin of Species by Means of Natural Selection,' demonstrated its validity. Could we add to the genetic method of natural science the quantitative method of exact science a great advance would be assured.

It is not possible to describe in a few words what has in fact been accomplished since Quetelet applied the Gauss theory of the distribution of errors to vital phenomena. If any trait, such as the height of men, depends on a great number of small causes, some tending to make them smaller and an equal number tending to

make them larger, then theoretically the deviations from the mean will be distributed in a certain symmetrical fashion, and measurements show that such a distribution does in fact approximately obtain. According to the Darwinian theory such chance variations as proved useful have by natural selection been preserved, and have given rise to new species and to organic evolution. The quantitative study of these variations, especially in their relations to heredity, is, I believe, the most pressing problem of biological science. The small amount of work hitherto accomplished has been chiefly carried out in England by Mr. Galton, Mr. Weldon, Mr. Bateson and Mr. Pearson. Mr. Galton has assumed the validity of the theoretical distribution. Mr. Pearson has shown that the distribution may be complex and nonsymmetrical, and has subjected it to mathematical analyses.

Turning now to the essays in this book, which are of special value because the scientific papers of the author are of such a technical character, as to make them unintelligible to many naturalists, we find the first to be on 'The Chances of Death.' Mr. Pearson explains the theory of deviations from the mean, and shows how mortality statistics may be analyzed into five 'skew' curves. Thus 'old age' mortality includes about one-half of all deaths. The maximum of the curve is at about 71 years, but it has a 'skewness' toward youth of 0.345. The mean is at about 65 years, with a 'standard deviation' of about 13.5 years and a limit on the old age side of 106.5 years. Components are then found representing the mortality of middle age, of youth, of childhood and of infancy. In the last case Mr. Pearson found that to secure a frequency curve it was necessary to take account of antenatal mortality, and that the curve discovered corresponds fairly well with the facts.

It is quite evident that the regular frequency curve does not represent mortality statistics or, indeed, most social and vital statistics. I have in several publications claimed that the ordinary frequency curve can in all actual cases be but an approximation. Mr. Pearson's skew curves allow us to express the facts with greater approximation, just as the orbits of planets are more nearly ellipses than circles. But, in fact, the orbits of the planets are endlessly complex, and so are the distributions of errors or deviations. Mr. Pearson claims to give a simple curve for infancy, but the material is not homogeneous. Antenatal mortality is due to causes different from those of infant mortality. The mortality of infants of the two sexes, of different races, of different classes, of those born at different seasons of the year, of those legitimate and those illegitimate, of those nursed by the mother and those brought up by hand, etc., has each a different distribution. In antenatal mortality there is a maximum at each four weeks, a greater maximum in the second and third months, etc. The curve for infancy would, in my opinion, need to be further broken up, quite beyond the possibility of mathematical analysis, in order to express the facts.

The second essay analyzes certain alleged results of Monte Carlo Roulette, and shows that they are deficient in short runs to an almost impossible degree. Presumably the published figures do not represent the actual falls of the ball, or it would be easy to 'break the bank.' The author does not give this explanation, and apparently does not notice that in one case the zeros (where the money goes to the bank) are only 499 instead of a most probable 840, a return perhaps intended to encourage the gambler. I must admit that I do not think that Mr. Pearson has made the best possible use of his time in tossing shillings 25,000 times, etc., in order to test the laws of probability. He might as well measure the sides of 25,000 right-angled triangles in order to see whether the square of the hypotheneuse is really equal to the sum of the squares of the other two sides.

The third essay, entitled 'Reproductive Selection,' is concerned with a statistical study of the size of families. The material is of much theoretical interest and of the greatest practical importance. If there is a complete correlation between fertility of parent and offspring, we might expect those having large families to supplant quickly all others, whereas it is not commonly supposed that those most fertile are those most fit for society. From 4,390 families, mostly of middle and upper Anglo-Saxon stock, Mr. Pearson finds that the most frequent

family, the 'mode,' is between two and three; the median family is about $3\frac{1}{4}$ and the mean family one larger. The median fertility is, however, about $5\frac{1}{2}$, and it follows from this that the most fertile quarter of the parents produce one half of the next generation. The same general relations hold for the extensive statistics of Copenhagen families collected by Rubin and Westergaard, but the fertility is greater. In both cases there is a deficiency, according to the theoretical distribution, of families of five and six children, due probably, as Mr. Pearson holds, to voluntary control. I cannot, however, agree with him that the curve shows that control is not exercised in the case of families of other sizes, or that in the case of no children it is excessive. In the latter case there are special anatomical and physiological causes producing sterility, which would not be factors in the amount of fertility.

Mr. Pearson finds that there is a selective death-rate increasing with increased fertility, but it would only slightly check 'reproductive selection,' and he concludes that in the case of civilized man natural selection at present appears to be quite secondary to reproductive selection as a factor of progressive evolution. An extreme Neo-Darwinian might, indeed, find it difficult to tell us why families do not increase indefinitely in size, or why infant mortality does not eliminate itself. We must believe that deviations from the mean are not always stable hereditarily and are in definite directions. The degree to which individual fertility is a stable variation can only be determined by statistics not yet collected. It is, however, clear that race or class fertility, whether due to physiological or psychological causes, will in a comparatively short time produce great changes in every race and in the survival of races. Thus the Bretons are supplanting other French stocks, and our New England stock is in danger of extermination.

The essay on 'Variation in Man and Woman' occupies one-third of the first volume. As the result of some 155 cases of variation for both sexes, covering a wide field, Mr. Pearson finds that woman is, relatively to size, not less, but probably slightly more, variable than man. This is contrary to the common opinion, but had been proved previously by Mr. Galton for sensation-areas. The variation in brain-weight is of special interest, but the data are so conflicting that they are not of great value; the coefficient of variation is, however, sensibly the same for the two sexes. Mr. Pearson criticises somewhat bitterly those who have assumed, on insufficient evidence, the greater variability of the male and drawn therefrom sociological conclusions. I think, however, that the experience of those who have taught both men and women will favor the greater intellectual variability of the male. The collation of examination papers marked without reference to these matters would be of interest. Supposing the male to be more variable in intellect and character, as seems sufficiently evident from the history of civilization, it would still remain undecided whether this were due to 'nature' or 'nurture,' and sociological inferences can only be drawn with caution.

This volume contains three essays criticising, respectively, Mr. Kidd's 'Social Evolution,' Lord Salisbury's 'President's Address' before the British Association and Mr. Balfour's 'Foundations of Belief.' Mr. Pearson has rather an easy task. Mr. Kidd's book received abundant attention and was lauded by Mr. Wallace in *Nature*, but it is already half forgotten. Mr. Pearson's arguments for the comparative unimportance of intra-group selection for human progress are, however, deserving of considers ation. Most men of science will agree with Mr. Pearson's arraignment of Lord Salisbury and Mr. Balfour. It is a particularly futile form of argument to pass from *ignoramus* to *ignorabimimus* and thence to *credendum est.* Mr. Pearson holds that the comparative orthodoxy of the Conservative leaders was of much advantage to them in the last elections. The writing of books on science and philosophy is, however, a kind of demagogy of which we should be glad to see some trace in America. Mr. Pearson is undoubtedly correct in stating that thoughtful men of science do not hold the materialistic views attributed to them by Mr. Balfour, but I am not sure that his own idealism helps greatly in treating the problems of physical science. When it is said that in science we are concerned not with phenomena,

but with 'a rational analysis of the contents of the human mind,' this is a statement that does not essentially affect the methods of science; but it seems somewhat dangerous to attempt to lessen the difficulties in the way of correlating atoms and the ether with other physical phenomena by regarding them as 'conceptual limits.'

The only essay in the first volume not yet noticed is concerned with the place of women in society, and with the relations of individualism and socialism—subjects which are more or less distinctly brought forward in many places. The second volume is, indeed, chiefly concerned with them, though indirectly, from the point of view of folk-customs and folk-lore. The four essays included in it are entitled 'Woman as Witch,' 'Ashiepattle,' 'Kindred Group-Marriage' and 'The German Passion-Play.' Limits of space do not permit me to give an account of these, and limitations of knowledge make me incompetent to criticise them. Mr. Pearson attributes great importance to a mother-age and its customs, and emphasizes the fact that mediæval Western Christianity was a product of the Teutonic folk-spirit.

Mr. Pearson's essays and lectures are *actuel* to an unusual degree. The scientific and social problems treated by him are those most pressing for solution and those most likely to become predominent in the course of the next twenty years. It is not too much to say that these volumes should be read by every man of science.

J. McKeen Cattell.

Columbia University.

SCIENTIFIC JOURNALS.

AMERICAN CHEMICAL JOURNAL, AUGUST.

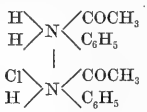
On the Oximes of Mucophenoxychloric and Mucophenoxybromic Acids: By H. B. Hill and J. A. Widtsoe. *On the Action of Aluminic Chloride and Benzol upon Mucochloryl Chloride, Mucobromyl Bromide, and the Corresponding Acids:* By H. B. Hill and F. L. Dunlap. These papers contain the results of investigations which have been carried out under Professor Hill's directions. It had been shown that mucochloric and mucobromic acids, when treated with hydroxylamine, formed normal oximes, which would indicate the presence of an aldehyde group in the acids. On the other hand, the bromanhydrides could be converted into crotonolactones by reduction, indicating an anhydride structure. The tautomerism of these acids has been the basis of the present work. Hill and Cornelison had attempted to discriminate between the two forms by a study of the action of hydroxylamine on the methylester of the acid, expecting to find that one of the forms would react readily, the other with difficulty. Although the free acids acted very quickly, the action with the methylester was very slight. When, however, one hydrogen of the acid was replaced by the phenoxy group, a substance was obtained whose ester acted readily and formed a substance identical with the ester made from the oximes by the action of methyliodide on the silver salt. The oximes and their derivatives were prepared and studied during the course of this investigation. The simplest explanation that could be offered to explain the conversion of the acids through their bromanhydrides into crotonolactones was that the acids were oxylactones. This was tested as follows: If the acid has an aldehyde structure it should, on treatment with aluminic chloride and benzol, yield an aldehyde phenylketone, while a substance belonging to the class of oxylactones should form a dichlorphenylcrotonic acid. The latter product was, in fact, the one obtained, and the authors consider the evidence sufficient to warrant the conclusion that the acid and its chloranhydride have the lactone structure.

On Certain Derivatives of Brommaleic and Chlormaleic Acid-Aldehydes: By H. B. Hill and E. T. Allen. The authors repeated the experiments of Limpricht which led to the formation of an acid-aldehyde of fumaric acid; but were unable to isolate any crystalline compound. The viscous liquid which they obtained had, however, the properties of an aldehyde. In attempts to prepare some derivative of this they obtained a product which they showed to be brommaleïc acid aldoxime. As this substance had not been previously prepared, its properties and many of its derivatives were studied. All attempts to prepare the acid itself failed. The corresponding chlorine compound can be made by the action of chlorine upon pyromucic acid.

Several interesting transformations were also studied.

On the Absorption of Oxygen by Tetrabromfurfuran: By H. A. TORREY. Although α-dibromfurfuran is readily oxidized by exposure to the air, tetrabromfurfuran, which likewise contains two bromine atoms in the α-position, undergoes no change under like conditions. Exposure to direct sunlight, however, produces a change which the author has shown to be due to oxidation. The product formed was shown to be dibrommaleyl bromide and the conditions most favorable for the action were studied.

On Halogen Addition-Products of the Anilides: By H. L. WHEELER, B. BARNES and J. H. PRATT. The authors have continued their work on the perhalides and compared them, as regards their crystallographic form, with the alkali perhalides. They found, however, that the perhalides of the anilides were not analogous in crystal form, and other facts also showed that the compounds from which the perhalides were prepared were not, as was supposed, substituted ammonium compounds. All these are derived from two molecules of an anilide with one of a halogen acid. Several structural formulas are suggested as theoretically possible; but they consider the evidence to favor the diammonium structure of which the following is an example:



A number of perhalides were prepared and their properties studied, both from a chemical and physical standpoint.

On the Permeation of Hot Platinum by Gases: By WYATT W. RANDALL. After giving a historical résumé of the work that has a bearing on this point the author gives the results observed in the preparation of pure hydrogen. The form of apparatus used, in which every possible precaution was taken to insure the purity of the hydrogen before it came in contact with the hot platinum, is given in detail. In these experiments the passage of the hydrogen was very slow as compared with the results obtained by Graham. Under the same conditions oxygen and nitrogen do not permeate the tube, and experiments made with marsh gas, which has a density only half that of oxygen, have so far given negative results. The hydrogen was examined spectroscopically, as this method was the most delicate for detecting the presence of other gases. The photographs all showed the so-called 'compound' spectrum. Whether this is evidence of some contamination can not yet be decided, as the evidence is not sufficient to settle this point.

On Some Malonic Acid Derivatives: By R. S. CURTISS. When ethylchlormalonate is treated with cold alcoholic ammonia a compound is formed in which the chlorine atom remains intact; whereas if the action is carried on in a sealed tube at 140° the chlorine atom is displaced. On treating ethylbrommalonate with aniline, a weaker base than ammonia, he obtained, as he expected, a compound in which the bromine was substituted, without affecting the carbethoxyl group. By treating ethylanilidomalonate with mercuric oxide he obtained ethyldianilidomalonate and also studied the action of sodium ethylate on ethyldibrommalonate.

The Action of Nitric Acid on Triphenylmethane: By E. S. SMITH. In attempting to prepare trinitrotriphenylmethane by the action of fuming nitric acid on triphenylmethane the author obtained in one case a compound which was shown to be triphenylcarbinol. This substance is usually made by the use of chromic acid as the oxidizing agent, but in the case mentioned the nitric acid acted in a similar manner.

Reviews of the following recent publications are also contained in this number of the *Journal*: Das Studium der technischen Chemie an den Universitäten und technischen Hochschulen Deutschlands und das Chemiker-Examen, F. Fischer; Water and Public Health, J. H. Fuertes; Frühling und Schulz's Anleitung zur Untersuchung der für die Zucker-Industrie in Betrachtkommenden Rohmaterialien, Producte, Nebenproducte und Hülfssubstanzen, R. Frühling; Tabellarische Uebersicht der Pyrazolderivate, G. Cohn; The Chlorination Process, E. B. Wilson; Tabellen für Gasanalysen, gasvolumetrische Analysen, Stickstoffbestimmungen, etc., G. Lunge.

J. ELLIOTT GILPIN.

SCIENCE

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THE TORONTO MEETING OF THE BRITISH ASSOCIATION.

THE British Association decided to meet in Montreal in 1884, with some hesitation, but after the great success of that meeting an invitation presented at Oxford in 1894, urging the Association to meet at Toronto in 1897, was accepted by the general committee with unanimity. Elaborate arrangements were made by the Dominion, by the City of Toronto and by the University, for the reception of the Association, and steamship, railway and cable companies united to offer unusual facilities to visitors. The chairman of the local committee, Professor Macallum, was especially self sacrificing in devoting himself for more than a year to the work of arrangement. A visit of the leaders of British science to Canada is an event of no common importance for the Dominion, and the enthusiasm was this year intensified by a United States tariff law and a British Jubilee.

The members and associates in attendance at Toronto numbered somewhat over 1,300, about 400 fewer than at the Montreal meeting. SCIENCE has already published an article by Professor Macallum giving a list of the more distinguished British and Continental men of science who expected to attend, and with a few exceptions, such as Lord Rayleigh, they were present. Men of science from the United States were well represented. The attendance from Great Britain, the Continent, Canada and the United States can best be indicated by giving the officers and committees of the various sections, which were as follows:

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Committee: Prof. Arthur; Prof. Atkinson; Prof. Barnes; Prof. Bessey; Prof. Britton; Prof. Campbell; Prof. Coulter; Dr. Fletcher; Dr. Galloway; Prof. Reynolds Green; Prof. Greene; Arthur Lister; Prof. MacDougal; Prof. Magnus; Dr. Saunders; Harold Wager; H. J. Webber.

Nearly all these scientific leaders and many others were present at Toronto when the Association was received by the civic authorities, at four o'clock on the afternoon of Wednesday, August 18th. Addresses of welcome were made by Lord Aberdeen, the Governor-General, and by the Mayor of the city. Replies were made by the retiring President of the Association, Lord Lister, by the incoming President, Sir John Evans and by Lord Kelvin. The Premier of the Province and the Minister of Education also made remarks. In the evening Lord Lister resigned the presidency to Sir John Evans, who gave the address already published in SCIENCE (page 269). Remarks thanking the President for his address were made by Lord Aberdeen, Lord Kelvin and Mayor Shaw.

Other general meetings of the Association were held to listen to the evening addresses by Professor W. C. Roberts-Austen and by Professor J. Milne. Professor Austen, on August 20th, lectured on 'Canada's Metals'. He reviewed the discovery and prospects of Canadian gold fields, illustrating the subject by a series of photographs, and called special attention to the nickel deposits of the Dominion. Illustrations were also shown of the speaker's interesting experiments on the splash of metals, and a demonstration was given showing on the screen the action of the electric furnace. Professor Milne, on Monday evening, lectured on a subject in which he is the leading authority, 'Earthquakes and Vol-

canoes.' He discussed especially the causes leading to the display of seismic and volcanic activity and the benefits to be derived from studying the phenomena. Dr. H. O. Forbes gave, on Saturday evening, the usual lecture to artisans, taking as his subject 'Borneo.' Meetings were also held for the conferring of degrees on several of the prominent members both by Toronto University and by Trinity College.

The arrangements for social intercourse and entertainment were numerous and attractive. A reception was given by the Governor-General and the Countess of Aberdeen on Thursday evening; there was a conversatzione in the University building on Tuesday evening and a banquet in honor of Lord Kelvin, Lord Lister and Sir John Evans on Wednesday evening. There were garden parties daily in the afternoons and many luncheons and dinners. Excursions were made on Saturday to Niagara Falls and in other directions, and for the Thursday following the meeting excursions were arranged to Montreal, Ottawa and elsewhere. Finally elaborate excursions were planned under the most favorable conditions to the maritime provinces and to Manitoba and the Pacific coast.

The business of the Association is transacted by the General Committee, chiefly on advice of the Council. This year part of the arrangements, including the election of officers for next year, were deferred until an autumn meeting in Great Britain. Professor Roberts-Austen was made General Secretary in succession to Mr. Vernon Harcourt, and in the room of the five members of the Council who retired there were elected F. Darwin, Esq., Sir C. W. Freemantle, Professor W. D. Halliburton, Professor S. P. Thompson and Sir W. H. White. Dr. F. Kohlrausch, Berlin; Dr. Van Rejckevorsel, Rotterdam, and Professor E. Zacharias, Hamburg, were made corresponding members.

The report of the Council adopted by the General Committee contained reports of two important committees appointed at the Liverpool meeting. The committee appointed to bring before the government the question of the establishment of a national physical laboratory has been in so far successful that the Treasury is taking the matter into consideration and has appointed a committee to report on such a laboratory.

The committee appointed to urge upon the government the importance of establishing a Bureau of Ethnology for Greater Britain, consisting of the President and General Officers, with Sir John Evans, Sir John Lubbock, Mr. C. H. Read and Professor Tylor, made the following report:

A central establishment in England, to which would come information with regard to the habits, beliefs and methods of government of the primitive peoples now existing would be of great service to science and of no inconsiderable utility to the government.

1. The efforts of the various societies which have, during the last twenty years, devoted themselves to collecting and publishing ethnological information have necessarily produced somewhat unequal, and therefore unsatisfactory, results. Such societies had, of course, to depend upon the reports of explorers, who usually travelled for another purpose than that in which the societies were interested; and such reports were naturally unsystematic, the observers being mostly untrained in the science. Again, whole regions would be unrepresented in the transactions of the societies, perhaps from the absence of the usual attractions of travellers, *e.g.*, big game or mineral riches. This has been to some extent corrected, at least as to the systematic nature of the reports, by the publication of 'Anthropological Notes and Queries,' by the Anthropological Institute, with the help of the British Association.

If it be admitted that the study of the human race is an important branch of science, no further argument is needed to commend the gathering of facts with regard to the conditions under which aboriginal races now live, and if this work is worth doing, it should be done without delay. With the exception, perhaps, of the negro, it would seem that none of the lower races are capable of living side by side with whites. The usual result of such contact is demoralization, physical decline and steady diminution of numbers;

in the case of the Tasmanians, entire disappearance. Such will probably soon be the fate of the Maories, the Andamanese, the North American Indians and the blacks of Australia. While these exist it is possible to preserve their traditions and folk-lore and to record their habits of life, their arts and the like, and such direct evidence is necessarily more valuable than accounts filtered through the recollection of the most intelligent white man.

It is scarcely necessary to enlarge upon this point, as no one will seriously question the value to science of such information. But it does seem necessary to urge that no time be lost.

2. As to the benefit, to the government, of these inquiries, the history of our relations with native tribes in India and the colonies is rich in examples. No one who has read of the ways of the African can doubt that a thorough study of his character, his beliefs and superstitions is a necessity for those who have to deal with him. And what is true of the natives of Africa is also true, in a greater or less degree, of all uncivilized races. Their ideas of common things and common acts are so radically different from those of civilized man that it is impossible for him to understand them without a special training.

Even in dealing with the highly civilized natives of India it is most necessary that an inquirer should be familiar with their religion and with the racial prejudices which the natives of India possess in common with other civilized nations.

A training in knowledge of native habits is now gone through by our officers, traders and missionaries on the spot; and by experience—sometimes dearly bought—they, after many failures, learn how to deal with the natives. By the establishment of such a bureau as is here advocated much might be done to train our officers before they go out, as is now done by the Dutch government, who have a handbook and a regular course of instruction as to life, laws, religion, etc., of the inhabitants of the Dutch Indies. The experience thus gained would then mature rapidly, and they would become valuable servants to the state more quickly.

The collecting of the necessary information for the Bureau could be done with but little expense and with a very small staff only, if the scheme were recognized and forwarded by the government. If instructions were issued, for instance, by the Colonial Office, the Foreign Office, the Admiralty, and the Intelligence Branch of the War Office, to the officers acting under each of these departments, not only that they were at liberty to conduct these inquiries, but that credit would be given to them officially for good work in this direction, there is little doubt that many observers qualified by their previous training would at once put themselves and their leisure at the disposal of the Bureau.

The Bureau itself, the central office, would be of necessity in London—in no other place could it properly serve its purpose—and preferably for the sake of economy and official control, it should be under the administration of some existing government office. But the various interests involved make it somewhat difficult to recommend where it should be placed. The Colonial Office would obviously present some advantages. The British Museum has been suggested, with good reason, and there appears to be no insuperable difficulty if the Trustees are willing to undertake the responsibility of controlling such a department.

The staff would not be numerous. A Director accustomed to deal with ethnological matter would necessarily direct the conduct of the inquiries, and until the material assumed large proportions two or three clerks would probably suffice. If the value of the results were considered to justify it, the increase of the area of operations over the world would probably call for additional assistance after the Bureau had been at work for a few years.

The Bureau of Ethnology in the United States aims chiefly at publishing its reports, but its area is limited to America. The scope of the present proposal is so much wider that the Committee think it better not to deal with the question of publication at present.

If this report be adopted by the Council it will be necessary to approach the government and impress upon them the importance of having such an organization for carrying out these recommendations. For this purpose a deputation should be appointed, and it would be well to invite the Council of the Anthropological Institute to appoint two members."

The Council resolved that the Trustees of the British Museum be requested to consider whether they could allow the proposed Bureau to be established in connection with the Museum; and if they are unable to sanction this proposal, that the authorities of the Imperial Institute be requested to undertake its establishment. The matter is now under the consideration of the Trustees of the British Museum.

The Report of the Corresponding Societies Committee for the past year, together with the list of the corresponding societies and the titles of the more important papers, and especially those referring to local

scientific investigations, published by those societies during the year ending June 1, 1897, was received.

One of the most important functions of the Association is represented by the work of its committees. In addition to the three reports to the Council many very valuable reports were presented at Toronto before the sections, which will be noticed in special articles on the work of the sections to be published in subsequent issues of SCIENCE.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

*LONG RANGE TEMPERATURE AND PRESSURE VARIABLES IN PHYSICS.**

METHODS OF PYROMETRY.

THE endeavor to provide suitable apparatus for high temperature measurement is one of long standing. The student of the subject is fairly overwhelmed with the variety of devices which have been proposed. There are few phenomena in physics which have not in some way or other been impressed into pyrometric service, often indeed by methods of exquisite physical torture. I cannot, of course, even advert to many of these this afternoon, as my purpose will have to be restricted to such devices as have usefully survived. Thus a whole group of 'intrinsic thermoscopes,' as Lord Kelvin calls them — apparatus in which some property of the substance is singled out for measurement—will be overlooked. Pyrometry will some day receive substantial aid from the phenomena of solid thermal expansion, dear to the hearts of old Wedgewood, of Professor Daniells, of the citoyen Guyton-Morveau, and recently to Professors Nichols, Joly and others; but even the 'meldometer,' which has received Ramsay's encouragement and recent heroic attempts to measure the expansion of platinum, have not yet entered the arena to stay.* The same may be said of vapor pressure, ebullition and certain dissociations, of which the former is entirely too liberal in dispensing pressure, and the latter too negligent in readjusting it. Little has been done with heat conduction regarded as subservient to the measurement of high temperatures; little with color and the spectrum, even though Draper and Langley in this country and many others abroad have paid tribute; little with polarization. The wave-length of sound has told Cagniard Latour and our own A. M. Mayer much about high temperature, but it did not tell them enough.

Throughout the history of pyrometry, *fusion* seems to have come forward for journeyman duty. What is more convenient than to find whether the degree of red heat is too low or too high from the fusion of prepared alloys. As far back as 1828 Prinsep, aware of the golden opportunity, with his golden air thermometer determined the melting point of some equally precious alloys of gold, silver and platinum, and determined them very well. Other alloys were afterwards substituted and graded mixtures made of quartz, chalk, kaolin and feldspar for the purpose. Efforts to obtain more accurate values are due to Becquerel; but the absolute values most widely used until quite recently, namely, the melting points of silver (958°), gold (1035°), copper (1054°), palladium (1500°), platinum (1775°), iridium (1950°), are due to the researches of Violle.

Interest in high temperature fusions has of recent date rather increased than abated. The demand for more accurate data has been met by the Reichsanstalt, and we have now a set of values for silver, copper, gold, nickel, palladium and platinum in terms of

* Address by Professor Carl Barus, Vice-President and Chairman of Section B (Physics).

* Noteworthy attempts to replace mercury by a liquid potassio-sodium alloy in glass thermometers are among the novelties.

the air thermometer standard of that institution. Data have also been supplied by Callendar. Among these values there is as yet considerable confusion and the end is not yet. Long ago I suspected that the Violle melting points were probably too low, whereas the assumed zinc boiling point is probably too high. This surmise has been partially borne out by the Reichsanstalt, though Le Chatelier even now prefers Violle's values.*

Thermoscopes based on a *specific heat* have an advantage over fusion thermoscopes in not being discontinuous. They are quite as 'intrinsic' and much less convenient in practice. Guyton-Morveau, at the beginning of the century, pointed out the pyrometer importance of specific heat, and a host of observers followed him. But the critical discussion of the subject is due to Pouillet (1836), who determined the thermal capacity of platinum between 0 and 1200° absolutely, and found a value so nearly constant as to place this method of pyrometry in a very favorable light. Other observers followed with new data, and the bulk of our knowledge to-day is again due to Violle. Violle used Deville and Troost's exhaustion air thermometer and determined the law of variations of specific heat and temperature throughout a large pyrometric interval, with a number of metals, silver, gold, copper, palladium, platinum, iridium, among them. It was by prolonging this law as far as fusion that the melting points of the metals, to which I have already alluded, were obtained. This verges on extrapolation, but it is not extrapolation gone mad.

The importance of calometric high temperature measurement has recently been accentuated in connection with the remarkable high temperature accomplishments of Moissan. Furnace temperatures in the case of such technological operations as are used in connection with iron, glass and porcelain manufacture rarely exceed 1,400°, except perhaps in the Bessemer process, where the temperatures are wont to exceed 1,600° and even reach 2,000°. In Moissan's furnace, which is essentially an electric arc enclosed by non-conducting lime, a totally new order of high temperatures is impressed. There was thus a call for at least an approximate measurement of their values, which was answered by Violle, assuming that the specific heat of carbon above 1,000° approaches a limit. The sufficiency of this hypothesis is not unchallenged, however; for instance, Le Chatelier finds that, up to 1,000°, the specific heat of carbon continually increases, having no certain limit. Admitting Violle's results, Moissan's furnace temperatures exceed 2,000° even at 30 amperes 55 volts; at 360 amperes and 70 volts tin and zinc oxides melt and boil; they exceed 3,000° at 500 amperes and 70 volts, where lime melts, and often boils. Moissan, however, went as far as 1,000 amperes at 50 volts.

The striking novelty of Moissan's work is rather of chemical interest, and a large part of it is so fresh in our memory that, in view of Moissan's forthcoming book,* I need merely glance at it. A range of fusibilities, among which platinum lies lowest, while chromium, molybdenum, uranium, tungsten, vanadium, follow in order, and of ebullitions beginning with silica and zinc oxide, is rather breath-taking. Finally, his structural investigations on the occurrence of carbon, and his long series of carbides, many of them commercially valuable, have staggered even the sensational press.

Leaving other intrinsic thermoscopes for the moment, I will ask your attention in

* The following table contains a brief summary :

Ag.	(Violle) 954°	(Barus) 986°–985°	(Callendar) 982°	(H.&W.) 971°
Au.	1045°	1091°–1093°	1037°	1072°
Cu.	1054°	1096°–1097°		1082°
Ni.	——	1476°–1517°		1484°
Pd.	1500°	1585°–1643°		1587°
Pt.	1775°	1757°–1855°		1780°

* Le four électrique, par Henri Moissan ; Paris, Steinheil.

this place to the development of the only fruitful method of absolute pyrometry which has yet been devised. I refer, of course, to the gas thermometer, or, in other words, to the manometric methods of measuring the thermal expansion of gases. Efforts have, indeed, been made to use gaseous viscosity for absolute high temperature work. It has been definitely pointed out, inasmuch as viscosity in gases is independent of pressure, while both viscosity and volume increase with temperature, that the transpiration rates of gases through capillary tubes of platinum glazed externally would necessarily be an exceedingly sensitive criterion of the variation of high temperatures. The small volume of the transpiration pyrometer as compared with the clumsy fragile bulb and appurtenances of the air thermometer is further to the point. But modern kinetics has as yet failed to fathom the law of variation of viscosity with temperature, and even the researches of O. E. Meyer in this direction do not seem to have quite touched bottom. Gaseous transpiration pyrometry is thus still much in the air, surveying the horizon of a glorious future.

Returning from this digression to the air thermometer, we find the first thoroughgoing piece of high temperature work carried out by Prinsep (1829), by the aid of a reservoir of pure gold to which I have already alluded. Prinsep's manometer was filled with olive oil, and the volume issuing at constant pressures was found by the balance. In view of the pure olive oil, probably available in 1829, these experiments must have been comfortably appetizing, and I dare say Prinsep's good humor in the matter may have contributed to the remarkable excellence of his results. Prinsep's researches were not superseded until Pouillet, in 1836, published his paper on pyrometry. Pouillet constructed an air thermometer bulb of platinum and was thus able to reach the farthest pyrometric north of the day and long after. His results are many sided; they contain the first definite data in radiation pyrometry and in calometric pyrometry. His constant pressure manometer, afterwards further perfected by Regnault, is the best apparatus for the purpose to-day. Pouillet did not suspect, indeed he remained quite unaware of, the permeability of platinum to furnace gases; perhaps for this and other reasons he failed to detect the thermo-electric anomalies in the platinum-iron couple which he so carefully calibrated.

It was thus a great step in advance when Deville and Troost long after replaced platinum by glazed porcelain, availing themselves (1857–60) of Dumas' famous vapor density method for measuring temperature. Unfortunately for the rapid progress of pyrometry, Deville and Troost used iodine vapor in their bulbs, a heavy gas indeed, but a gas, as was afterwards found, whose low temperature molecule dissociates at higher temperatures. Thus they unwittingly committed an even greater error than Pouillet in gliding over permeable platinum, and their data for the boiling points of zinc and of cadmium were about 100° too high. In fact, these results were challenged not long after by Becquerel (1863), who had fallen heir to Pouillet's platinum air thermometer, had used it to calibrate a platinum-palladium thermocouple of his own, and had found data for the boiling points of zinc and cadmium upwards of 110° below those of Deville and Troost. I cannot here enter upon the discussion which thereafter arose between these active observers further than to state that in the course of it both parties frequently repeated their measurements (Becquerel even substituting a porcelain bulb for Pouillet's thermometer) without removing the decrepancy between their values.

Later researches have decided in favor

of Becquerel's results, and his original research, with its applications to fusion, to radiation, to thermo-electrics, etc., is one of the noteworthy accomplishments in the history of pyrometry. Nevertheless, it must not be forgotten that to the investigation of Deville and Troost our knowledge of the perviousness of iron, platinum and other metals to gases is due. We are also indebted to Deville for the great discovery of dissociation, the very phenomenon which he was here so loth to acknowledge. This is the case of a man stumbling in his own footprints. Victor Meyer was, I believe, the first to point out the probable dissociability of the iodine molecule, suggesting a fruitful subject of research which has since been extended to many other molecules.

In 1863 Deville and Troost began a new series of high temperature researches, the feature of which is the perfected form of porcelain bulb. This was a hollow sphere and long capillary stem adapted for use with Regnault's standard air thermometer. Great difficulties were encountered in the endeavor to glaze the bulbs within. They were finally overcome by making bulb and stem separately and then soldering them together with feldspar before the oxy-hydrogen blow pipe. Elaborate measurements on the thermal expansion of Bayeux porcelain accompany these researches which, undertaken together with M. Gosse of the Bayeux works, occupied them intermittently for about seven years. A full summary of their data did not appear, however, until 1880, when, together with a new vacuum method of high temperature air thermometry, they communicated the results of twenty-seven measurements on the boiling point of zinc. Their new results are in good accord with the data of Becquerel already cited and the more recent results of Violle and others for the same landmark in the region of high temperatures. Measurements between 0° and 1500° had thus reached a degree of precision of about 15° in 1000°.

The further development of pyrometry took a somewhat different direction. Regnault (1861) had already made use of a displacement method, in which the measuring gas is removed bodily into the measuring apparatus by an absorbable gas. But the method was independently revived by Professor Crafts, of the Boston Institute of Technology. These methods are not of especial excellence below 1500° ; but above that temperature, when most solids tend to become viscous, their importance increases (as Crafts duly pointed out) in proportion to the rapidity with which the measuring operations can be completed. One or two minutes may suffice and different gases may be tested consecutively. It is in this way that Victor Meyer and his pupils, after demonstrating the dissociation of iodine and chlorine molecules, succeeded in penetrating quantitatively to very much less accessible heights of temperature. A particular desideratum was a rigid test as to the stability of the molecule of the standard measuring gases (oxygen, hydrogen, nitrogen). The results were favorable, inasmuch as for these and for many gases like CO_2, SO_2, HCl, Hg, etc., the expansions obtained were linear functions of each other.

In their final work, temperatures as high as 1700° were reached, the air thermometer for this purpose being tubular in form, consisting of very refractory fire clay with an interior and exterior lining of platinum and with two end tubulures of platinum for influx and efflux of gases. Among many results of great chemical interest their researches showed that metallic vapors, phosphorus, sulphur, etc., at high temperatures tend to pass into the monatomic or the diatomic molecular structure.

Sometime after (1887) a series of experiments furthering the line of research of

Deville and Troost were made, with a geologic aim in view, in the laboratory of the U. S. Geological Survey. Finally, porcelain air thermometry was taken up with great vigor by the Reichsanstalt. These results, due to Holborn and Wien, are now almost exclusively quoted and carry the stamp of the great institution from which they emanated. They have been wisely made commercially available by the deposition, with Heräus, in Hanau (Germany), of a platinum rhodium alloy definitely calibrated for a temperature range of 1400°.

Apart from this, these researches contain no essential novelty, except, perhaps, a more detailed attempt to investigate the stem error of the thermometer bulb; their procedure otherwise is identical with the method developed in this country. I am not, therefore, inclined to yield to it the unhesitating deference which has become customary. There can be no doubt, in view of the splendid facilities due to the cooperation of the Royal Prussian porcelain works—facilities which those who have been baffled by porcelain technology, or have had to coax unwilling manufacturers into reluctant compliance, will appreciate—that the data of the Reichsanstalt will eventually be standard. For the present, however, I should be more impressed by some sterling novelty either in the direction of a larger range of measurement or of method. Conceding that an accuracy of 5° at 1000° has been reached, all results above 1500° remain none the less subject to increasingly hazardous surmise.

A beautiful method of absolute thermometry, albeit as yet only partially developed, is due to Töpler. In this the densities of communicating columns of gas are compared very much as in Dulong and Arago's classical methods for liquids, by the gravitation pressures which correspond to these unequally hot columns. To accomplish such extremely fine pressure measurement, Töpler invented the 'Druck libelle,' an inversion, as it were, of the common level, in which, therefore, the motion of the bubble (or of a thread of liquid) indicates a change of pressure conditioned by the invariable horizontality of the instrument.

The development of the practical forms of continuous intrinsic thermoscopes (the *radiation*, the *thermo-electric* and the electric *resistance* methods) went, more or less, hand in hand with the development of the air-thermometer, although the latter is decidedly the more recent. Aside from pioneering experiments of Müller (1858) and others, the well-known Siemens resistance pyrometer (1871) was the first instrument in the field. It was based upon data obtained from platinum, copper and iron by the calometric method of calibration. This instrument has been remarkably perfected by Callendar and Griffiths, using specially pure platinum calibrated by comparison with the air-thermometer as far as about 600°. Notwithstanding these improvements, the resistance pyrometer is inferior, in my judgment, to the thermo-electric pyrometer, from the greater bulk and fragility of the exposed parts and the tendency of platinum to disgregate or waste itself gradually at high temperatures. Its upper limit of temperature measurement is thus limited; for, even if the difficulty of selecting suitable terminals for the coil is set aside, the difficulty of finding an insulator at very high temperatures would remain. According to Holborn and Wien resistance is seriously subject to the influence of furnace gases, and permanence of the low temperature constants does not imply a like permanence of the high temperature constants of the metal.

Radiation pyrometry, curiously enough, is the most venerable method within the whole scope of the subject. It was introduced by Newton (1701) in his *scala graduum caloris* in connection with his well-

known law of cooling. Not to mention minor workers, it was successively attacked and revived in most of the noteworthy high temperature investigations. Pouillet and Draper have studied it; Becquerel, Crova, Violle, Le Chatelier, Langley, Nichols, Paschen and others have advanced it. It remains to-day the most promising as well as puzzlingly fascinating subject for pyrometric research. One needs merely advert to its broad scope in relation to the temperature of the heavenly bodies to acknowledge this. Here I can only allude to Becquerel's principle that the radiation of opaque bodies is spectrometrically alike at the same temperature, a result which has Crova's more recent assent; to Violle's photometric measurements of the total emission of platinum; to the more recent work in the same direction of Violle and Le Chatelier, in which consistent results were obtained for oxide of iron and platinum as far as 1500° to 1700°; to Stefan's law as proved by Boltzmann, and the variety of discussion it has elicited; to H. F. Weber's collateral equation; to the Johns Hopkins measurements, etc. Another school of observers, including Langley, Paschen and others, has undertaken the promising but much more laborious method of bolometric measurement of the distribution of spectrum energy in its relation to temperature. Without doubt, however, the whole subject is yet *in primis rudimentis;* the results are confessedly 'intrinsic.' Indeed, vagueness in the nature of the radiating source lowers with sufficiently threatening aspect to chill the fondest hopes. When one is told by Violle working on Mont Blanc that the temperature of the sun is 2500°; thereupon by Rossetti that it is 9965°, by Le Chatelier that it is at least 7600°, by Paschen that it is below 5000°, by Wilson and Gray that it is 8000°, etc., one wisely concludes that more may yet be learned about it. Our sympathies naturally go with those who, like Lummer and Wien and the Johns Hopkins people, are beginning fundamentally with the search for an absolutely black body. Less superstructure and more sub-cellar is, perhaps, the watchword in radiation pyrometry.

Turning, now, to the last and most important of the methods of practical pyrometry, we find a curiously meandering evolution apparent. I have already indicated that Pouillet (1836) was the first to complete a legitimate piece of calibration work. Pouillet might have condemned the method, but for some reason Tait's thermoelectric anomalies of red-hot iron were not detected. Regnault (1847), who was the next to take up the subject as it happened with the same couple, made his condemnation sweeping enough. It was not the real perversity of the platinum iron couple which provoked Regnault, for of this neither he nor Pouillet became aware. Regnault's objection (as we should put it to-day) lay in the fact that the thermocouple obeyed Ohm's law, which in that early day lay somewhat beyond the great physicist's range of interest. Fortunately, but none the less long after, Becquerel followed with his palladium and divers platinum couples, carefully calibrated and efficiently used. What these platinum couples were is not stated. They cannot have been very sensitive or they would have been preferred to the palladium-platinum couple. Indeed, the metallurgy of platinum alloys did not reach a degree of refinement until Deville and Debray (1875) overhauled the chemical separation of platinum metals with particular reference, both to iridium and to rhodium. Recently Mylius and Förster at the Reichsanstalt further contributed to platinum metallurgy. But in view of the toils in which the whole subject of high temperature measurement languished in Becquerel's day, his results were not sufficient to remove the discredit

which Regnault had thrown upon thermo-electric pyrometry. And so it happened that the return to the method in recent date was of the nature of a resuscitation.

It is amusing to note, as we pass on, the pranks of custom as it bore down upon pyrometry. Following Deville and Troost, every worker (I might mention at least five) felt in duty bound to redetermine the boiling point of zinc—rather a difficult feat in its way. Thus we find boiling zinc inseparably associated with the destiny of the calibrated thermo-couple. Le Chatelier broke this law of fateful sequence by ignoring the need of calibration at the outset, and then using the couple so dignified to determine the melting points of silver, gold, palladium and platinum. But these are Violle's melting points. Hence the pyrometric feature of Le Chatelier's platinum-rhodium couple was in its inception due to Violle.

Meanwhile, accompanying the geologic inquiries of Clarence King, an extensive series of pyrometric investigations which had been in progress in this country since 1882 were completed (1887). These contained a full examination of divers efficient methods of pyrometry and a study of the porcelain air-thermometer with particular reference to the calibration of thermo-couples. In the course of this work the admirable pyrometric qualities of the platinum iridium alloy were exhibited by detailed and direct comparisons with the air thermometer. It was shown that the calibration could be made permanent by referring the thermo-electromotive forces to a Clark's cell; that the character of their variation with temperature is uniformly regular, and that the thermal sensitiveness of the couples increases as the higher degrees of red and white heat are approached. Finally, it was pointed out that couples destroyed by silicate corrosion or in similar ways could be restored by fusing over again on the lime hearth with merely negligible changes of constants. Elsewhere, Le Chatelier's clever combination of the platinum rhodium couple with the D'Arsonval galvanometer, then a comparatively new instrument in the laboratory, secured immediate favor. Professor Roberts-Austen, ever on the watch to waft good things across the channel from Gaul into Albion, hailed the new comer with no uncertain sound. Sometime after, the platinum-rhodium couple entered Germany and was there definitely calibrated (1892) for the first time, as already stated, at the Reichsanstalt.

Of the three available couples, palladium, platinum-rhodium and platinum-iridium, the former is excluded from competition by reason of its low fusibility. Between platinum-iridium and platinum-rhodium, the latter has been more extensively advertised, but is otherwise inferior to the older platinum-iridium alloy. In other words, platinum-iridium, when suitably alloyed, can be made more sensitive than platinum-rhodium in the ratio 100 to 76. Beyond this the alloys are much alike; both are tenacious, resilient, refractory metals, and their thermo-electric forces under like conditions of temperature show a constant ratio even at extreme white heats. The thermo-electric activity of these two alloys is exceedingly remarkable. Among over fifty different platinum alloys examined no similarly sensitive combinations were found. Moreover, whereas platinum alloys of extremely large electrical resistance are not unusual, such metals are not apt to be distinguished thermo-electrically.

To conclude: the small dimensions of the sensitive point of the thermo-couple, the independence of the intermediate temperatures between the junctions (apart from small corrections due to the Thomson effect) and therefore the removal of the terminal difficulty, the high upper limit of the measurable temperatures, the perma-

nence of its constants in relation to Clark's cell in the lapse of time, the instantaneity of its indications, the easy reproduction of destroyed couples, their relative insensitiveness to furnace gases, the regular and simple character of the temperature function, the sustained sensitiveness throughout all temperature ranges even quite into the fusion of platinum—all these facts are a sufficient if not overwhelming recommendation of the method.

In speaking of long range temperature variables one is hardly permitted to overlook the remarkable work which has recently been done in the direction of low temperature, but with these subjects I am less familiar and can therefore only refer to in passing. The progress made in the subject is sufficiently evidenced by the growth of large low temperature laboratories throughout the world, laboratories which undertake 'the cold storage' of 'cold storage,' as it were, like those of Pictet in Berlin and Paris, of Dewar in London, of Kamerlingh Onnes in Leyden, of Olezewski in Krakau, and others. Dewar and Fleming have added to our knowledge of the probable constitution of bodies at the absolute temperature. Olezewski has found the critical temperature of hydrogen at —230° and its atmospheric boiling point at —243°. Dewar and Moissan have liquefied fluorine. There is much here which I must reluctantly forego. The hydrogen thermometer, the platinum balance (Callendar) and the thermo-couple are again doing excellent work in thermometry.

APPLICATIONS OF PYROMETRY.

Turning now to the applications of recent pyrometry, we meet first many series of valuable data on melting points and similarly valuable data on the dissociation temperatures of chemical compounds. To these I merely refer, not being qualified to enter into chemical interpretations. High temperature boiling points have also been treated, and I will especially consider the case of the variation of metallic ebullition with pressure. The relation of vapor pressure to temperature has thus far defied the counsels of the wise, even though such men as Bertrand and Dupré have given the matter close scrutiny. One would suspect the simplest relation to hold for metallic boiling points, and investigations have therefore been undertaken in which the temperature of ebullition of Hg, Cd, Zn, Bi, were studied for pressures decreasing from one atmosphere down indefinitely.

The results so obtained show an effect of pressure regularly more marked as the normal boiling point is higher, so that the attempt to express the phenomenon for all these bodies by a common equation is roughly successful. By far the most rapid reduction of boiling point occurs when the pressure decreases from $\frac{1}{10}$ atmosphere indefinitely. For the case in which the normal boiling point is to be predicted from a low pressure value in case of a metal which, like bismuth, boils with great difficulty, very high exhaustion is essential.

Igneous fusion, by which I mean the fusion of rock-forming magmas, is particularly interesting in its relation to pressure. This has been again recently pointed out by Clarence King in his discussion of the age of the earth. If the earth is solid within, as is now generally admitted, such solidity can only result from superincumbent pressure withholding fusion. To study the relation of melting point to pressure directly is out of the question when white heat is the condition of fusion. In this respect the laboratory in the interior of the sun or even of the planets has some salient advantages, but we cannot comfortably put such a laboratory under strict surveillance of protoplasm.

Fortunately, the Clapeyron equation, successively improved by James Thomson and

by Clausius, is here usefully available. To measure the melting point, the difference of specific volumes of the solid and the liquid body and the latent heat of fusion at this temperature, with the aid of Joule's equivalent, is to measure also the relation of melting point to pressure implicitly. Based on the first and second laws of thermodynamics, this equation is generally true, no matter what specific properties may characterize the body. The process has thus far been completely pushed through for diabase only. Thermal change of volume may be measured by enclosing the rock in a platinum tube of known expansion, and the contraction of the contents from liquid to solid found by an electric micrometer probe reaching within the tube. Given a furnace fully under control, then, as experiment has shown, the cooling can be made to take place so slowly that platinum remains rigid relatively to its charge of red-hot magma, and under these conditions the contraction can actually be followed into the solid state. At the same time the temperature at which marked change of volume occurs is the melting point. Apart from difficulties of manipulation, the latent heat may be found from measurement of thermal capacity on either side of the temperature of fusion by a modification of known methods.

The rate at which fusion is retarded by pressure computed from these data in the manner specified showed an increase of the melting point of a silicate of about 0.025°C. per superincumbent atmosphere. But this datum falls within the margin (.02 . . . .04) of corresponding data much more easily and directly derived for organic bodies. One may, therefore, argue that if the melting point pressure rate is so nearly constant on passing from the class of silicious to the thoroughly different and much more compressible class of organic bodies the rate would probably be more nearly constant in the same body (silicious or organic), changed only as to temperature and pressure. This surmise was verified for naphthalene within an interval of 2,000 atmospheres.

The endeavor to interpret the change during fusion of the volume of the chemical elements in terms of the periodic system has been begun with much success by Max Töpler for low temperatures. It would be of great interest to complete this diagram for high temperatures in view of the specifically molecular character of the fusion phenomenon, by repeating such experiments as have just been described for rock magmas.

The heat conduction of rocks has been investigated in many cases for temperatures lying below red heat. Among recent observers we need only instance the extensive investigations of Ayrton and Perry. No trustworthy experiments, however, have yet been carried into the region of essentially high temperature; and yet what is chiefly of interest in the geological applications of such experiments is the change of conduction which accompanies changes of physical state, whether induced by pressure or by temperature.

Experiments in heat conduction are difficult under any circumstances. They become insuperably so when conduction at white heat is to be studied under pressure, and that is what the geological conditions actually imply. Some notion of a body respectively solid and liquid at a given temperature may be obtained by observing the behavior of bodies which are capable of being undercooled. A number of such bodies are known, thymol being a conspicuous example. Experiments with this body were made by measuring the volume expansion, specific heat and heat conduction in parallel series both for the solid and liquid state at like temperatures. They showed, for instance, that the increment of

absolute heat conduction, encountered in passing isothermally from the solid to the liquid state, when referred to solid conductivity is about 15%, and when referred to a liquid conductivity is about 15%. Similarly the change of thermometric conductivity under like conditions is an increment of 36% and 56% respectively. Now, since in most questions relating to thermal flow thermometric conduction enters exclusively, the importance of this large coefficient is obvious whenever a body passes from the solid to the liquid state.

Solid conduction is thus 40 or 50% in excess of liquid conductivity for the same body at the same temperature and pressure. It is reasonable to infer that a corresponding decrement of conduction will accompany any rise of temperature of a solid body. Measurements which have somewhat recently been made for relatively small intervals at Zurich, at Glasgow and at Harvard, upon typical rocks, all bear out this surmise. The immediate incentive to these experiments was a strong paper by Professor Perry in which Lord Kelvin's estimate of the age of the earth is shown to be insufficient for an earth in which the interior conductivity is systematically greater than the surface conductivity. Indeed, he deduces the percentage increment of the square root of the age of a Perry earth over that of a Kelvin earth to be one-fifth of the percentage decrement of conduction for each 100° C. So far as the effect of terrestrial temperature alone is concerned, the measurements just mentioned show that Perry's correction is negative or that Perry's earth would be less long-lived than the 100×10^6 limit of years set by Lord Kelvin.*

To estimate the effect on heat conduction of the increase of pressure which accompanies the increase of temperature with the depth below the surface is a much more serious matter. In the laboratory, pressure experiments are limited to 3,000 or 4,000 atmospheres; compared with earth pressures these scarcely amount to a scratch on the surface; yet even for this limit the determination of heat conduction at high temperatures is out of the question. A tentative method of arriving at a conclusion is given by Clarence King in his discussion of the age of the earth, the consequences of which have been quite overlooked. What King endeavored to accentuate long before Perry's contribution to the subject was precisely the fact we *cannot* assume greater conductivity for the interior than for the surface. Since heat conduction decreases isothermally from solid to liquid, it is assumed that in one and the same substance the viscosity could be taken as an index of the thermal conduction. Therefore, if temperature and pressure were made to vary in such a way (both increasing) as to leave viscosity constant, it was inferred that heat conduction would also remain constant. Now the isometrics or lines of constant viscosity of a viscous body for variable pressure and temperature are much more easily found than the isometrics of conduction. In fact, it has been shown that a burden of at least 200 atmospheres would have to be brought to bear in order to wipe out the decreased viscosity due to the rise of a single degree (Centigrade) of temperature. The depth at which this ratio is reached, as King points out, for a given surface gradient of temperature and depth, depends on the initial excess of the temperature of the earth considered, and on the age of the temperature distribution resulting. But no matter whether the Kelvin earth with an initial excess of 3,900° and an age of 100×10^6 years, or whether King's solid earth with an initial temperature of fused platinum and 25×10^6 years of life be taken, in all cases the temperature effect predominates

*The text of Kelvin's recent address at the Victoria Institute, in which an age of thirty million years is maintained, has not yet reached me.

throughout those depths within which change of temperature with depth is the marked feature of the temperature distribution. In other words, if, for example, we consider the Kelvin earth, the strata above .035 of earth radius will be strata of smaller conduction than the surface strata. From the surface downward as far as .035 radius, conduction will decrease to a minimum. Below this, conduction will increase again, due to preponderating pressure, finally to exceed the surface value. But the computed temperature distribution of Kelvin's earth is such that at .035 radius the initial temperature excess of 3,900° has been reached to within one or two per cent. Below this in depth Perry's correction will begin to apply, but the further changes of temperature are so nearly negligible that the consideration of conduction is superfluous. From this point of view, therefore, the staggering force of Perry's clever argument is removed. Of course, I am fully aware that an argument from the supposed parallelism of physical properties of a given body (in the present case heat conduction and viscosity) is not inevitably convincing; but in physical geology, for some time to come I dare say, the question will be not one of rigorous proof, but rather one of forming a rational opinion.

In passing I will indicate the importance of an increased knowledge of the isometrics of liquid and solid matter, relations which have thus far been found simpler in character than other thermo-dynamic properties, as I shall again point out in the course of the address.

I want finally to add a few words on the electro-chemistry of magmas. The physical chemistry of molten rock has already been somewhat extensively considered, but I am hardly competent to review it. In this country, Joseph Iddings and, more recently, George F. Becker have discussed the natural differentiation of magmas from different points of view. Here I will merely include certain pyrometric experiments on the electric conduction of fused glasses which seem to give promise of throwing light on the chemical constitution of complex silicates and to be suggestive in other ways. In such measurements, if the magma is made to pass from the solid to the liquid state, the observed electric conduction contains no evidence either of a melting point or of polymerism. The law of thermal variation is easily derived and it agrees closely with the corresponding behavior of a zinc sulphate solution, for instance, observed through a range of temperature. In a general way, electric resistance decreases in geometric progression when temperature increases in arithmetical progression. Considered relatively to the composition of the magmas, electric conduction shows a marked and regular increase with the degree of the acidity of the magmas. The less fusible acid magmas are better conductors than the basic magmas at the same temperature. Curiously enough, conduction thus runs in an opposite direction to fusibility. However viscous a magma may be, therefore, and however cogent the arguments, such as those launched by Becker against the differentiating importance of ordinary diffusion may prove, it is fair to conclude that a thorough change of chemical structure through *ionic* diffusion, whether directed by an electric field or otherwise, must be an easy possibility for a sufficiently hot but otherwise solid magma. The results point specifically to the desirability of repeating Hittorf's brilliant experiments on the migration of the ions for a silicious medium. This ought not to be difficult, seeing that such a menstrum need not even be liquid to be compatible with a high order of electric conduction.

Further consideration of the subject shows the probable passage of conduction through a maximum when acidity is con-

tinually increased. Finally quartz appears like an insulator in the same rôle as water in ordinary aqueous solutions. In all these cases I wish to keep in mind the results of Alexeëff and their recent repetition for metallic alloys, together with the interpretation of these results due to Masson. In a crust subject to variable magnetism, traversed by earth currents, sustained by semimetallic carbides of the Mendeleëff-Moissan type, containing piezo-electric and thermoelectric sources, who can say that electric fields are absent? Again, the character of the changes contemplated in Gibbs' famous 'phase rule,' as interpreted by Le Chatelier, would here be ionic rather than molecular.

A question of somewhat allied interest in the action of hot water under pressure on rock-forming silicates. Investigations of this kind have been described in the well-known and fascinating book of Daubrée. Daubrée's work, however, is qualitative in character, like that of many others in the same line, and the furtherance of the subject is to be looked for in the quantitative direction. Some time ago Becker suggested experiments on a huge mass of granulated rock under the action of steam at exceptionally constant temperature. But no thermal effect of the action of water could be detected. True, the boiling point of water is a temperature comparatively low for the purpose; yet similar experiments made with liquid water at over 200° under pressure were equally negative as to results. Experiments of this kind are not very conclusive. The insufficient sensitiveness of the measuring apparatus, the rate at which heat is carried off compared with the rate of generation and other obscure causes mar the results. The question may, however, be approached in a somewhat different way: If water is heated under pressure in glass tubes, the volume of water contained decreases as the square, whereas the chemically active area, *i. e.*, the inside surface of the tube, decreases as the first power of the diameter. Hence, in proportion as the tube is more capillary, the action of water on the glass will produce accentuated volume effects. Thus it was shown that the behavior of hot water is profoundly modified by its continued action on glass, inasmuch as its compressibility increases at a very rapid rate with the time of action even at 180°, until, with the approach of solidification, the observed compressibility is fully three times its isothermal value at the inception of the experiment. Even more striking is the simultaneous and continual decrease of the length of the column of water. Clearly, therefore, the confined volumes of glass and included water must undergo contraction at 180° in forming an eventually solid aqueous silicate, while increasing compressibility is due to the increasing quantity of silicate dissolved. Now, in nearly all cases the effect of solution is a decrease of compressibility. Hence the increased compressibility observed is to be referred to a precipitation of the dissolved silicate, in response to the action of pressure, a result borne out by the appearance of the tube and by varied correlative experiments. It is, however, the volume contraction which is particularly interesting, because of its far-reaching geological application. In the first place the measurements show that about .025 cubic cm. of liquid water is absorbed per square centimeter of glass surface at 180° C. per hour.* The effect of this absorption is a contraction of bulk amounting to 18% per hour. So large and rapid a contraction is presumably accompanied by the evolution of heat. Hence, under conditions given within the first five miles of the earth's crust, *i. e.*, if water at a temperature above 200° and under sufficient pressure to keep it liquid be so circumstanced that the heat produced

* This is an initial rate of about 180 kilograms per square meter per year.

cannot easily escape, the arrangement in question is virtually a furnace whose efficiency accelerates with rise of temperature or increase of terrestrial depth.

PIEZOMETRY.

It is not feasible to make much progress in pyrometry without feeling the need of a corresponding development in high pressure measurement. This has already appeared in the preceding parts of my address. It will not be expedient to look into the history of the subject as comprehensively as I did in the case of pyrometry, partly because the literature is more diffuse, and partly because the real development of piezometry is of recent date and virtually begins with pressures of the order of several thousand atmospheres. So understood, although we gladly pay homage to Oersted, to Regnault, to Grassi and many others, our historical summary may be abridged.

As is often the case in physics, the great advances in the subject are associated with the name of one man; for, though many able investigators have contributed effectively to the progress of piezometry, the overshadowing importance of the results of Amagat have superseded all researches coextensive with his own. For over twenty years Amagat has been laboring on this definitely circumscribed subject. Year after year his prolific experimental ingenuity has put forth results, each of which in its turn constituted the highest attainment in accuracy and the greatest breadth of scope which high pressure measurement had reached at the time. It is impossible to give any adequate view of this sustained labor in an address. The subject is highly specialized and demands special treatment; but we owe to Amagat the bulk of our knowledge of the properties of a gas regarded not as an ideal fluid, but as a physical body; some of the most far-reaching results in the thermo-dynamics of liquids, and some of the best data in the elastics of solids.

Amagat investigated gases within an interval of pressure which at times reached 4,000 atmospheres, with a view to interpreting their divergence from the laws of ideal gaseity. Indeed, we may note in passing that just as the advanced astronomy of the day is being enriched with unexpected discoveries from a discussion of mere errors of observation, so refined physical measurement gleans new harvests in carefully tracing out the all but rigorous sufficiency of established laws. The product of pressure and volume, nearly constant in the ordinary isothermal behavior of gas, shows, under higher pressures, a well-marked passage through a minimum in the case of all gases except hydrogen. Hence, below a certain definite pressure, varying with the character of the body (say 40 atm.), gases are more compressible than Boyle's law asserts, and above this pressure they are continually less compressible and begin to resemble hydrogen in this respect. The sharpness of the minimum diminishes as temperature increases, and probably ultimately vanishes. Cailletet, it is true, had undertaken a study of the same subject simultaneously, but his results were not in the same degree correct. Again, the coefficient of expansion of gases, considered in its isopiestic behavior for temperatures not too far above the critical point, increases with pressure to a maximum, which seems to occur at the same pressure for which the volume-pressure product is a minimum. This thermal maximum also decreases with temperature and finally vanishes. To specify the conditions further than this would be to exceed the limits beyond which verbal statement ceases to be lucid. The value of Amagat's work, however, is not merely the formulation of such general laws for gases as a whole, but rather the investigation of sharp and specific results for each gas individually. Thus,

if one uses these data for a given gas to compute the contestants in Van der Waal's law, one is actually able to predict remote critical conditions of the gas in question with a fair order of accuracy.

Whenever pressure measurements are to be made through such large intervals as are here in question, the elastic constants of the apparatus become of increasing moment. Amagat, however, treated these incidental measurements as of like importance with the rest of his labors. The starting point of his investigation into high pressures was the open mercury manometer first erected along a staircase near Lyons, finally in the shaft of the St. Etienne mine, about 380 meters deep. This apparatus was used for graduating the closed manometer, preferably containing nitrogen. In later experiments for excessively high pressures the closed manometer was replaced by the 'manomètre à pistons libres,' a sort of inverted Bramah press, in which the small pressures of an open mercury manometer acting on a large piston compensate the relatively large pressures of the piezometer acting on a small piston. The ingenious feature of Amagat's apparatus is the rotation of both pistons just before measurement, a device by which friction is rendered harmless. Equipped with this instrument direct determination of the bulk modulus for glass and metal was actually feasible. In the case of glass no serious variation of the compressibility could be ascertained within 2,000 atmospheres, and even 200°, an observation of great value in practical research. Poisson's ratio was similarly determined and the data used in computing Young's modulus. But the most important result of these researches, a result to which Professor Tait also contributed, is the datum found for the absolute compressibility of mercury. This will enable all future observers in piezometry to standardize the apparatus with ease and nicety.

Time prevents me from dwelling upon the remaining investigations of Amagat in a measure commensurate with their value. These contain a counterpart for the liquid state of the results already announced for gases. The change of volume throughout enormous pressures and about 200° of temperature is considered in detail for a number of important liquids. Only in one case, and that the rather remarkable one of carbon tetrachloride, are evidences of solidification encountered and the conditions determined. Amagat believes the absence of solidification to be due to the occurrence of the lower critical temperature below the isothermal of compression. In my own judgment, however, the pressures necessary to reach this lower critical point will be enormous even in units of 1,000 atmospheres, for which reason it is not in any case liable to be an easy conquest.

Special mention finally is due to the thermal position of the maximum density of water, which Tait had already studied. Amagat shows definitely that the temperature of maximum density moves towards the freezing point with increasing pressure, so that at high pressures, as well as at high temperatures, the behavior of water loses its anomalous character. In general, compressibility and expansion decrease with pressure for all normal liquids, and expansion increases rapidly with temperature. Other anomalous properties of water have been investigated, among which the diminished viscosity of water under pressure at ordinary temperature studied by Röntgen, Cohen and others may be stated.

After this cursory and wholly inadequate mention of the work of Amagat and the physicists who, like Tait, Cailletet and others, have been engaged in closely allied researches, it will repay us to look at some of the other as yet less splendidly developed contributions to piezometry. At the outset it is well to make mention of the forms of

pressure gauges which have come into use. As far as 1,000 atmospheres, the Bourdon gauge, if well constructed, does good service, though in a somewhat rough way. The corrected nitrogen closed manometer is more accurate for a smaller range. A theoretically simpler pressure gauge was proposed by Tait and Cailletet. In this case a straight cylindrical elastic tube under internal or external pressure is substituted for the Bourdon tube and the expansion or compression is directly measured. With due precautions against changes of temperature and the choice of a solid of constant bulk modulus and rigidity, this gauge can be used as far as about 2,000 atmospheres with convenience.

Above 2,000 atmospheres Amagat's Bramah press manometer, already mentioned, is the only reliable gauge, and, though somewhat cumbersome, has the advantage of giving absolute results. However, a gauge based on the change of electric resistance of mercury with pressure, a constant now fairly well known from Palmer's measurements, will, in my judgment, do good service for pressures which exceed even the range of the manometer. With regard to methods for producing high pressures, the force pump, with a small steel plunger and the screw advancing bodily into a closed barrel filled with a liquid, have not yet been superseded. The efficiency of such apparatus depends essentially on the means used for obviating leakage. These must, of course, be very perfect.

Amagat's work with liquids was extended chiefly in the direction of high pressures Experiments have since been made by others throughout higher temperatures (310°) and, of course, a smaller range of pressures (500 atm.). Leaving out the less perspicuous results, I will here merely allude to the probable existence of a remarkable law which these researches have developed. Dupré (1869) and afterwards Lévy (1878), reasoning from thermo-dynamic premises, were the first to suspect that the isometrics or lines of equal volume of liquids are straight. In other words, if there is to be no change of volume then pressure increments must vary proportionately to the temperature increments ($p=a\,\theta-b$), a result which implies that the internal pressure of a body kept at constant volume is proportional to its temperature. Lévy's deduction was, however, declared to be theoretically unwarrantable by Clausius, Boltzmann and others. Sometime after, the same law reappeared in experimental form in a series of brilliant researches on critical temperatures due to Ramsay and Young. Fitzgerald, reasoning from Ramsay and Young's results, then proved that for such liquids as possessed straight isometrics specific heat is a temperature function only, and energy and entropy are each expressible as the sum of a mere temperature function and a mere volume function. This is curiously like the position from which Dupré and Lévy started. Ramsay and Young's work, however, applied specifically to vapors, and for high temperatures (200°) their pressures did not exceed 60 atmospheres. The law has since been tested for liquids as far as 1500 atmospheres and over 200° conjointly, and found in reasonable accordance with experiment. Hence we infer that if the thermo-dynamic change of a body is such that volume remains constant, pressure and temperature will vary linearly with each other, the increments being about 0.1° C. per atmosphere. Now, although any law relating to the liquid state would be welcome, these volume isometrics are particularly so. In the geology of the earth's crust, for instance, they would, in a great measure, determine the conditions of possible convection; and it is curious to note that, from the known values of bulk modulus and of the expansion of solid glass, the isometrics

would here again be given by corresponding increments of about .1° per atmosphere. For solid metals the isometrics are of a different order.

Another line of research for liquids to which I attach supreme importance has only just been begun: I refer to the systematic study of the *entropy* of liquids. Among the first results on the heat produced in suddenly compressing a liquid are those of Tait. They are of too limited a range, however, and not in good accord with the more recent and extended data of Galopin. Generally speaking, the change of temperature produced per atmosphere of compression increases with temperature in a marked degree, as one may infer from Kelvin's equation. For organic bodies this increment at ordinary temperatures is of the order of $\frac{1}{50}° = .020°$ per atmosphere. In case of liquid metals the order of values is decidedly different, being about $\frac{1}{10}$ this value, recalling correspondingly divergent results observed for the isometrics of volume. Quite recently (1896), the same subject has been taken up by Tammann (to whom we also owe results for the correlative compressibility) particularly for solutions and with reference to the theory of solutions. Tammann's data are of the order .001° per atmosphere at 0°, and in better keeping with the thermo-dynamics of the subject than the earlier experiments. Much more, however, must be done before anything like a degree of critical accuracy is approached or a broad survey taken. Pressure intervals are to be chosen wider and the temperature measurement given with greater certainty.

Finally, I wish to touch upon the relations of melting point and pressure in their more recent development. Obviously, the classical work of Andrews on the continuous passage of a liquid into the gaseous state will find some counterpart in the manner in which the analogous passage from the solid into the liquid state takes place. The character of these phenomena may be shown from direct observations of melting point and pressure, as was done by the earlier observers. Full knowledge, however, can be obtained only by mapping out the isothermals throughout the region of fusion very similarly to the method pursued by Andrews himself for vaporization. This has thus far been attempted for a single body only, naphthalene, within 130° and 2,000 atmospheres. Six isotherms (63°, 83°, 90°, 100°, 117°, 130°) were traced within these intervals, along each of which, excepting the first, the body passed from the liquid to the solid state under the influence of pressure only. An exhibit of these data shows strikingly that in all cases the change of physical state takes place in accordance with a cyclic law, *i. e.*, a larger pressure is necessary to change the body from the liquid to the solid state, at a given temperature, than the pressure at which the body at the same temperature again spontaneously melts. Freezing almost always seems to take place at once; the corresponding fusion is apt to be prolonged, and in its gradual occurrence traces the contours of James Thomson's well-known, doubly-inflected isothermals much more fully than does the allied case of vaporization.

The appearance of the cyclic parts of these isothermals is suggestive, and may be described in terms of their dimensions in the direction of volume and of pressure respectively. The former dimensions indicate the probable fate of the volume increment. They show that, as pressure and temperature increase, the volume increment tends more and more fully to vanish, and they thus imply a lower critical temperature at which the solid would change into the liquid continuously as far as volume is concerned. It does not follow that other properties of the body would here also vary

continuously. For naphthalene this point would lie in a region of several thousand atmospheres and several hundred degrees Centigrade—therefore, in a region too remote to admit of actual approach.

Again, the breadth of the cycles, measured along the pressure axis, decreases from the center of the field both in the direction of increasing and decreasing pressures. The tenor of these results is an additional indication of the recurrence of a lower critical temperature at which cycles must necessarily vanish. The decrease of the breadth of the cycles in the direction of decreasing pressure suggest the possible occurrence of a point in the region of negative external pressure, so circumstanced that beyond it the substance would solidify at a lower pressure than that at which it fuses. This may be interpreted as follows: The normal type of fusion changes continuously into the ice-type of fusion through a transitional type characterized by the absence of volume lag.

An independent discussion more searching in character has quite recently been given by Tammann. Tammann points out that for the normal case of fusion and for increasing pressure the two determinative factors of the Clapeyron equation—the volumes and latent heat of fusion—will not in general simultaneously become and remain zero. He argues that the volume constant will at the outset decrease with pressure passing through zero to negative values. Hence the curve representing the relation of melting point to pressure must initially rise to a maximum when the melting point pressure ratio is zero, and then decrease. Contemporaneously, the latent heat of fusion, decreasing continually with pressure, eventually also reaches zero, but at a much later stage than the volume constant. At this stage, therefore, since the melting point and the volume constant now have definite values (the latter negative), the melting point and pressure ratio is negatively infinite. Hence the curve expressing the relation of melting point to pressure decreases with increasing pressure from the maximum specified, as far as the pressure at which latent heat is zero, and there drops vertically downward. Thus Tammann's melting point pressure curve, with its initial and final ordinate in the direction of temperature, maps out a field of pressure and temperature within which the body is solid. Outside of this region the body is liquid and cannot by pressure alone be conceivably converted into the solid state. Any thermo-dynamic change involving a march through the boundary of this region is accompanied by the discontinuity of fusion, of viscosity, etc. A march through the final ordinate (for which latent heat is zero) is probably not accompanied by such discontinuity. For a given temperature there may be two fusion pressures. At a temperature sufficiently below the melting point the continued increase of pressure should, therefore, move the normally fusing body from the solid into the liquid state continuously. This is a somewhat anomalous result of close reasoning, but it must not be forgotten that in the depth of our ignorance of the actual occurrences above several thousand atmospheres the term anomaly is a misnomer. Indeed, if we regard the melting pressure curve beyond the stated maximum as characterizing the ice type of fusion (which Tammann does not do) our difficulties would in a measure be reconciled.

Tammann finally points out that the term lower critical temperature is not justified by the character of the phenomenon. Data for melting point and pressure due to Damien seem directly to corroborate the occurrence of zero values in the ratio of melting point and pressure increments, but Damien's tests are restricted to a pressure interval much too small to be trustworthy.

Of the two bodies which have been tested throughout long pressure intervals, naphthalene shows a linear melting point and pressure ratio for 2,000 atmospheres, while the carbon tetrachloride of Amagat, though initially concave upward, soon also becomes linear. Clarence King has, therefore, in geological considerations so represented it. To conform with Tammann's inferences the interior of the earth would have to be a fluid.

One point of issue, however, in these cases is clear: At Andrews' critical temperature both the difference of specific volumes and the latent heat of fusion vanish simultaneously wherever observed. Under corresponding conditions of change from liquid to solid the internal pressures are of tremendously greater value for both states, and the passage of the solid into the liquid molecule may involve an immense transfer of energy without any corresponding change of volume, for the density of the molecule itself eludes observation. The manner of this isothermal change from one state to the next is in all cases along the characteristic doubly-inflected contour first pointed out by Thomson for vapors, and since elaborated by Van der Waals, Clausius and others. We may, for brevity, call this a *volume lag* and measure it in terms of the pressure or the volume interval subtended. The liquid can exist even above the critical temperature, which would mean that even here pressure must be reduced below the critical pressure in order to rupture the liquid molecule.

Pronounced as these phenomena are for the change from gas to liquid, they become much more remarkable, indeed often formidable, for the change from liquid to solid. In this case a volume lag subtending more than 100 atmospheres is the rule. In other words, it takes much greater pressure to solidify a liquid at a given temperature than to liquefy the solid. Among all these cases there is a group of well-known bodies in which, while the solidification pressure is of marked intensity, the isothermal pressure of spontaneous fusion may even be below zero or be in the region of negative pressure. Take the single example of thymol among many: This body between zero Centigrade and its melting point at 53° can be kept in either the solid or the liquid state of pleasure. Given at about 50° in the liquid state it would require more than 2,000 atmospheres to solidify it. If solid it must obviously remain so even if pressure be wholly removed. But thymol may be similarly treated beginning with the undercooled liquid state at 28°, *i. e.*, 25° below its melting point. Even here at least one thousand atmospheres are needed to condense it (400 have been tried quite ineffectively). Once solid it would require about 1,000 atmospheres of *negative* external pressure again to melt it. In other words, it could not be melted again on the same isothermal.

If we but knew more about the physical constants involved in these transformations we could predict the results along the lines of J. W. Gibbs' splendid theory of the equilibrium of heterogeneous mixtures; but, with the dearth of our concrete knowledge of long range physical phenomena relating to liquids and solids, we must be content with humbler methods.

I have always regarded the significant behavior instanced for the case of thymol as capable of a broad interpretation. Professors J. J. Thomson and Fitzgerald abroad, and Elihu Thomson in this country, have recently sought for atomic dissociation in the electrolyzed vacuum of a Crookes' tube. Speaking to the same point, I would venture to assert that we may reasonably look to the volume lag for a rational account of the genesis of atoms. We have already met with two orders of volume lag: the first at the mergence of gas into liquid being usually a few atmospheres in isothermal

value; the second at the mergence of liquid into solid, a hundred or even one thousand times as large in isothermal value, and characterized by the fact that, whereas freezing pressures may be enormous, the corresponding isothermal melting pressure may even be markedly negative.

If, then, we further inquire as to what will happen if we indefinitely compress the solid along a suitable isothermal, I think it is logically presumable that, with the succeeding and profoundly accentuated volume lag, we shall reach the next atom in a scale of increasing atomic weights.

However enormous the condensation pressure for this purpose may be, it is supposable, in the light of the examples already given, that along an accessible isothermal the disintegrating external pressure of the new atom may be permanently negative. Hence the new atom will persist within the pressure and temperature range available in the laboratory.

But the last stage is virtually identical with the first, or the inherent nature of these changes is periodic. The inference is therefore that, under suitable thermal conditions and continually increasing pressure, the evolution of atoms, of molecules, of changes of physical state, again of atoms and so on indefinitely, are successive stages of periodically recurring volume lag.

CARL BARUS.

BROWN UNIVERSITY.

THE AMERICAN MATHEMATICAL SOCIETY.

THE American Mathematical Society held its fourth annual meeting at Toronto, Canada, on Monday and Tuesday, August 16th and 17th. All conditions were exceptionally favorable for the success of the meeting, but the result far exceeded all anticipations. Forty-four members of the Society were registered as in attendance, forming by far the largest body of mathematicians ever brought together on this continent. Among those present were Professor Simon Newcomb, President of the Society, and former Presidents Dr. G. W. Hill and Dr. Emory McClintock. Several distinguished visitors also attended the meeting, among them Professors A. R. Forsyth, A. G. Greenhill and O. Henrici. Twenty-three papers were presented, all by members of the Society. Although the great length of the program necessitated a severe limitation of time for the reading of each paper, the hearty cooperation of the authors with the plans of the committee enabled the Society to conclude the sessions in the two days allowed without the least friction. The meeting was characterized not only by great scientific interest, but also by a cordial spirit of good feeling between hosts and guests.

At the meeting of the Council on Monday evening three persons were elected to membership in the Society and three nominations were received. It was decided to hold the next summer meeting of the Society at Boston, Mass., at or about the time of the meeting of the American Association for the Advancement of Science. Resolutions were adopted by the Society in recognition of the generous hospitality of the University of Toronto and its officers.

A portion of the afternoon session on Tuesday was devoted to a general discussion of the topics mentioned below. The members of the Society were afterward received by President and Mrs. Loudon, of the University of Toronto. On Tuesday evening the members of the Council were entertained at the Toronto Club by Professor Alfred Baker.

The following is a complete list of the papers presented:

MONDAY MORNING.

1. *Upon the representation by ruled surfaces of the curves drawn by mechanisms. Preliminary report, illustrated by models:* DR. EDWIN M. BLAKE, Purdue University.

2. *A contribution to the theory of plane curves:* DR. L. WAYLAND DOWLING, University of Wisconsin.

3. *A Canadian discoverer of the non-Euclidean Geometry:* PROFESSOR GEORGE BRUCE HALSTED, University of Texas.

4. *Note on the Folium of Descartes:* PROFESSOR ELLEN HAYES, Wellesley College.

5. *A geometrical locus connected with a system of coaxal circles:* PROFESSOR THOS. F. HOLGATE, Northwestern University.

6. *On the solution of the map-color problem:* PROFESSOR P. WERNICKE, State College of Kentucky.

7. *On the Riemann-Helmholz-Lie problem of the foundations of geometry:* PROFESSOR H. B. NEWSON, University of Kansas.

MONDAY AFTERNOON.

8. *Quaternion invariantive operators:* PROFESSOR JAMES BYRNIE SHAW, Illinois College.

9. *The geometry of some differential expressions in hexaspherical coordinates:* DR. VIRGIL SNYDER, Cornell University.

10. *On certain differential equations of the second order allied to Hermite's equation:* PROFESSOR E. B. VAN VLECK, Wesleyan University.

11. *Concerning the cubic involution and the cubic transformation of elliptic functions:* PROFESSOR OSKAR BOLZA, University of Chicago.

12. *The determination of the rational function in the reduction of the general Abelian integral to the sum of a rational function and a fundamental system of elementary integrals:* DR. J. C. FIELDS, Berlin, Germany.

13. *On the reduction of hyperelliptic functions ($p=2$) to elliptic functions by a transformation of the second degree:* D. J. I. HUTCHINSON, Cornell University.

TUESDAY MORNING.

14. *Further researches in the theory of quintic equations:* DR. EMORY MCCLINTOCK, New York, N. Y.

15. *A theorem concerning the coefficients of lineal substituting groups of finite order with n variables:* PROFESSOR H. MASCHKE, Chicago University.

16. *On the commutator groups:* DR. G. A. MILLER, Ann Arbor, Mich.

17. *Collineations in a plane with invariant conic or cubic curves:* PROFESSOR H. S. WHITE, Northwestern University.

TUESDAY AFTERNOON.

18. *Concerning regular triple systems:* PROFESSOR E. H. MOORE, University of Chicago.

19. *Theory of discrete manifolds:* MR. F. W. FRANKLAND, New York, N. Y.

20. *Certain transformation problems of canonical equations of dynamics:* DR. EDGAR ODELL LOVETT, University of Chicago.

21. *The true transition curve:* MR. P. H. PHILBRICK, Lake Charles, La.

22. *About sixth power numbers whose sum is a sixth power:* DR. ARTEMAS MARTIN, Washington, D. C.

23. *Preliminary report on alternate functions of complex numbers:* PROFESSOR A. S. HATHAWAY, Rose Polytechnic Institute.

General discussion of the following topics:

1. *The accurate definition of the subject-matter of modern mathematics.*

2. *The vocabulary of mathematics. The possibility of correcting and enriching it by cooperative action.*

F. N. COLE,
Secretary.

CURRENT NOTES ON PHYSIOGRAPHY.

ARTESIAN WELLS OF IOWA.

A COMPREHENSIVE report on the artesian wells of Iowa by W. H. Norton (Iowa Geol. Surv., VI., 1896, 113–428) brings clearly forward the favorable conditions there obtaining for this important source of water supply. The paleozoic strata have a gentle southward inclination, and also a sag over the northern part of the State from the eastern and western boundaries towards a median line. Numerous water-bearing strata, or *aquifers*, occur, from the basal sandstone that lies on the buried hills and valleys of the Algonkian floor to the sandstones of the coal measures. Cretaceous strata in the northwestern part of the State lead water away westward. Some important wells are supplied from aquifers in the glacial drift. Three artesian wells were mentioned in the State Survey Report for 1870, and no systems of water works had been then constructed. About a hundred systems are now in operation, many of them depending on artesian supply. At certain points, where many wells have been sunk, the first yield has slightly decreased, as if the limit of local supply had been reached; but great stores of subterranean water remain unexhausted beneath most of the State.

FORESTS AND DESERTS OF ARIZONA.

THE variation of climate with altitude

and the redemption of the desert along irrigated valleys afford material for an entertaining narrative by Fernow (Nat. Geogr. Mag., VIII., 1897, 203–226). Much of the lower ground is desolate, unless exceptional rains allow a temporary growth; but the few valleys of streams large enough to feed irrigating canals contain green groves, orchards and fields. The higher plateaus and volcanoes bear forests of open growth; about Flagstaff 12,000,000 feet of lumber are cut annually. The open grouping of the trees is ascribed to variation in water storage by the soil. Although millions of pine seedlings spring up after the rains, all of them perish from frost, unless the season is exceptionally favorable. The young tree growth does not follow in annual generations, but in irregular periods of from three to ten years. Open grassy glades of fine black loam seem to mark the site of extinguished lakes. Brief account is given of an ascent of San Francisco mountain and of a visit to the Grand Canyon of the Colorado, but it seems rather negligent of the rest of the world to speak of even the unrivalled canyon as 'a thought of God on earth expressed.'

TRANSVERSE VALLEYS IN THE JURA.

A NEW contribution to the above much-discussed question is made by Dr. Fr. Jenny, (Das Birsthal: ein Beitrag zur Kenntniss der Thalbildung in Faltengebirge, Basel, 1897), with the conclusion that the several transverse valleys or *cluses* of the Birse are the result of backward erosion along lines of local distortion in the anticlinal ridges, whereby the river course has become more or less adjusted to the structure of the region. It is argued that in the early stages of folding, the drainage was consequent, and that several temporary lakes were then formed. Local deformation in the growing arches defined the river course. "The Birse has gained its present course by a change from its original path through adjustment to the structure of the mountains that it traverses."

It is not clear whether the author advocates the diversion of early consequent streams to transverse courses by the headwater growth of diverting streams or not; no explicit statement being made on this point. The antecedent origin of the rivers, advocated by Foerste and Rollier, is discarded. Yet a qualified antecedent origin is implied, for the present river course is given an early date, before the folding was nearly completed; as if consequent on the early folding and antecedent to the rest. The value of adjustment to internal structures in locating the river seems exaggerated. Even if essentially antecedent, the slight adjustments now found within the cluses might have taken place as the valleys were deepened. Moreover, it is highly probable that slight irregularities of structure, such as those to which Jenny ascribes the location of the existing cluses, would have been found wherever the cluses had been cut down across the anticlines. The frequent occurrence of cluses near the end of pitching anticlines is quite as suggestive of a course consequent upon initial folding and antecedent to later and greater folding as of dependence on slight local deformations.

SUB-OCEANIC CHANGES.

MILNE draws attention to sub-oceanic changes (London Geogr. Journ., X., 1897, 129–146) caused by slides of detritus down the marginal slopes of continental plateaus. Cables are there broken in consequence of their burial beneath such slides. The cause of the movement is ascribed to the accumulation of land-worn detritus. In Japan a large number of earthquakes come from the deep sea off the mouth of the Tonegawa, the largest of Japanese rivers, which crosses an alluvial plain in its lower course. Many other shocks on those islands have similar

origin. Where long continental slopes descend beneath the ocean at a steeper gradient than 1 in 35, slips and earthquakes of this kind may be expected. The western boundary of the Tuscarora deep, in the North Pacific, is a source of many earthquakes, among them the destructive disturbance of June 15, 1896. There Milne infers 'sudden sub-oceanic changes along the basal frontier of a continent, the magnitude of which it is difficult to estimate.' Certain 'unfelt earthquakes' recognized by the horizontal pendulum are recorded at widely separated stations, 'and it is fair to assume that in these instances the whole world has been shaken.' Their source cannot have been on any land, for then they must have been observed in the ordinary manner; they are therefore ascribed to submarine movements.

If the occurrence of sub-oceanic slides be verified, they afford a new argument for the permanence of continents and oceans; for nowhere do the sedimentary strata of the continents exhibit so confused a structure as must be thus produced along the slope and basal frontier of a continental mass.

W. M. DAVIS.

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CURRENT NOTES ON ANTHROPOLOGY.

STONE IMPLEMENTS FROM THE POTOMAC DISTRICT.

PROFESSOR WILLIAM H. HOLMES contributes to the Fifteenth Annual Report of the Bureau of Ethnology one of his excellent and beautiful papers, this one on the 'Stone Implements of the Potomac Chesapeake Tidewater Province,' 152 pages, with 104 full-page plates, and 36 figures in the text. The geographical and geological relations of the area are carefully explained, and the artefacts themselves are examined under the classification of flaked, battered or abraded, and incised or cut stone implements and utensils. The typical forms and characters are illustrated, the processes of manufacture are set forth, and the extensive quarries where the material was obtained are described.

The conclusion of the author, after years of patient research with reference to the antiquity of man's work in this region, may be given in his own words (p. 146): "The art remains preserved to our time indicate the prevalence of extremely simple conditions of life throughout the past, and exhibit no features at variance with those characterizing the historic occupancy." So that we shall have to go elsewhere to find 'paleolithic man.'

ETHNOGRAPHY OF THE CALCHAQUIS.

IN SCIENCE, May 7th, I referred to some interesting art remains discovered by Ambrosetti in the territory of the ancient Calchaquis. Ethnographers have been unable to identify these with any modern tribe (see 'The American Race,' p. 319). The latest effort is by Dr. Ten Kate. He availed himself of a series of skeletons in the Museo de La Plata, exhumed from old graves in Calchaqui territory. Some were deformed, and of the normal there were a number of types; but the characteristic features were extreme brachycephaly and a short stature. In both respects these ancient differed from the modern natives of the place. Looking around for similarities, Dr. Ten Kate found them among the Huarpes of the province of La Rioja, where skeletons with the same traits occur. He does not, however, identify them with the Huarpes (or Allentiacs), who are probably related to the Chaco tribes, but rather with the Araucanian stock, so far as one can judge from the synopsis of his conclusions in the *Centralblatt für Anthropologie.*

These analogies are not borne out by the linguistic evidence of the proper names in

Calchaqui territory, which rather points to Aymara or Kechua affinities as undoubtedly to the arts of this extinct population.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

MODERN ALCHEMY.

DR. H. CARRINGTON BOLTON contributes to the last *Chemical News* an article entitled 'Recent Progress of Alchemy in America.' It is largely devoted to such details as are known of the claims of Dr. Stephen H. Emmens, of New York, and of Edward C. Brice, of Chicago, together with the Mint Report on the Brice process. Dr. Emmens is the inventor of the high explosive Emmensite, and the author of the 'Argentaurum Papers.' It is perhaps worth while to give a brief abstract of his claims, taken from his own publications. He states that he was led to his present study by the investigation in 1892, at the instance of Commodore Folger, of a specimen of rustless nickel steel, which it was proposed to use for torpedo netting. He says that he found in both nickel and iron, and subsequently in cobalt, 'a certain product which seemed to differ from anything recorded in the text books.' Inferring that, if such a substance were found common to the metals of the fourth series of Mendeléeff's group eight, similar results would be found in other groups, he began the study of gold and silver. 'By certain physical methods and by the aid of certain apparatus' he claims to have succeeded in bringing about an extremely minute subdivision of silver, and was 'surprised to find that the substance obtained differed so far from ordinary silver that it could no longer be regarded as the same elementary substance.' His alleged substance, which he calls *argentaurum*, symbol *Ar*, he considers to be the missing element between silver and gold in the second subdivision of Mendéeleft's group two. "Argentaurum can be aggregated into molecules having a density considerably superior to that of silver molecules, and, we think, identical with that of ordinary gold molecules. Whether we are right as to this or not, the condensed argentaurum presents the appearance and is endowed with the properties of ordinary metallic gold." Dr. Emmens estimates that 'one ounce of silver will produce three quarters of an ounce of gold' at a profit of at least three dollars an ounce. He operates on Mexican dollars, and has sold to the U. S. assay office six ingots of an alloy of silver and gold aggregating in value $954.80. Dr. Emmens remarks: "The gold-producing work in our argentaurum laboratory is a case of sheer mammon seeking; it is not being carried on for the sake of science, or in a proselytizing spirit; no disciples are desired and no believers are asked for. I have every confidence that the production of argentaurum gold will be brought up to 50,000 ounces monthly within a year." Should this result be attained, the problem of bimetallism will be happily solved.

REGARDING the Brice process, three government experts worked for three weeks under Mr. Brice's direction, and officially report: "We have seen not the slightest evidence of any 'creation' or transmutation. On the contrary, the claimant failed in every instance to recover the entire amount of silver and gold known to be present in the materials. The claimant seems to have devised a variety of irrational and wasteful methods for recovering a portion of the silver and gold known to metallurgists as being present in many commercial metals, such as antimony and lead." Mr. Brice's application for a patent has been again rejected. Incidentally, the assay office investigation revealed that commercial antimony contains a very small percentage of gold, which is recovered by the Brice process.

APROPOS of argentaurum, Dr. Emmens and Newton W. Emmens publish in the *Chemical News* a short article on 'Migrant Matter,' describing an experiment in which a disc of pure lead connected with a disc of pure silver by a copper spiral was kept in a wide-mouthed bottle for twelve weeks. At the end of this period the lead disc on cupellation is said to have given a silver bead weighing 0.00003 gram. "It would appear from this experiment that what is commonly recognized as solid silver is, in part at least, a migrant mode of matter * * *. We use the term 'migrant matter' because the traveling particles to which we refer are (in common with odors generally) much more akin to Crookes's 'fourth form' than to gases."

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE INTERNATIONAL MEDICAL CONGRESS.

THE New York *Medical Record*, with great enterprise, secured by cable a report, extending to a number of pages, of the Twelfth International Medical Congress, which opened at Moscow on August 19th. After the Congress had been opened by the Grand Duke Sergius and welcomed by the Minister of Public Instruction, Hospodin Dylianov, Professor Sklifosovsky, the President of the Committee of Organization, made an address in which he dwelt especially on the relations of Russia to the rest of Europe in regard to medical and scientific work. He said that one great obstacle to medical progress was the want of a common medium of communication between the men of science of different nationalities. Nowhere was this almost fatal lack so fully realized as in Russia. The great mass of Russian medical literature was a sealed book to Western peoples, and few outside of the country had any conception of the enormous amount of scientific work that was being done there. Russians recognized that their language was too difficult ever to become universally known, and they were therefore the more keenly alive to the necessity of the adoption of some international speech. He would suggest the appointment of a committee to draft a preliminary agreement on the subject, which should be laid before the next congress for consideration. The General Secretary, Professor Roth, reported an attendance of 7,300 members in Moscow. Of this number more than 3,500 were from Russia, 800 from Germany, as many from Austria, 400 from France, 300 from Italy, 300 from England, 120 from the United States, 30 from Mexico, 10 from Japan and 4 from China. Prince Gallitzin, the Mayor of Moscow, then greeted the members of the Congress on behalf of the municipality and announced that the city of Moscow had decided to establish a prize of 5,000 francs, to be awarded at each international congress, to the person who in the interval since the preceding congress shall have done that medical work which shall be deemed of the greatest benefit to humanity. Addresses were then made by the national delegates, and the honorary presidents were announced as follows: Germany—Virchow, Leyden, Ziemssen and Waldeyer; Austria — Gussenbauer, Hlawa and Rudiger; Great Britain—Stokes, MacCormac and Simpson; United States—Senn and Thayer (Billings, it was announced, would have been one of this number had he not been absent); Spain—Robert; France—Lannelongue, Le Dentu, Grasset and Pinard; Italy—D'Antona, Bottini and Lombroso.

General addresses were given by Professor Virchow on the continuity of life; by Professor Lannelongue on the sclerogenic treatment of surgical tuberculosis; by Dr. T. Lauder Brunton on the relationship of physiology, pharmacology, pathology and practical medicine; by Professor von Krafft-Ebing on etiology of progressive general paralysis; by Dr. Senn on classification and surgical treatment of acute peritonitis; by Dr. Metchnikoff on the plague, and by Dr. Robert on the mutual relations of pathology and therapeutics.

The next international congress will be held at Paris in the summer of 1900, with Professor Lannelongue as President of the Committee of Organization.

THE SEAL FISHERIES.

DR. DAVID STARR JORDAN, Commissioner-in-chief of the fur seal investigations for the United

States, with Mr. George Clark, Secretary of the Committee, arrived at San Francisco on the 25th. Mr. Macoun, the Canadian Commissioner, had already left the Pribyloff Islands, and the British Commissioner, Professor Thompson, was about to leave on H. M. S. 'Amphion.' Mr. Lucas, of the United States Commission, remained behind for a week. President Jordan is reported in a press dispatch to have said that the breeding grounds showed a shrinkage of about 15 per cent. over the conditions of last season, and the hunting grounds a shrinkage of 33 per cent. This is about what was predicted by the American Commission last year. The primary cause of the shrinkage of females on the breeding grounds is the pelagic catch of last fall and this spring. To this is added the loss due to starvation of orphaned pups in 1894, which should this year have lived to give birth to their first pups. This starvation in 1894, affecting, as it did, in a like measure the male herd, is the cause of the diminution of the killable seals on the hunting grounds. The decline of the herd is everywhere more distinctly marked than it was last year, owing to the effects of the resumption of pelagic killing in Bering Sea after the *modus vivendi* of 1893. For 1898 the shrinkage will be still greater, through the destruction, in 1894, of unborn pups with females killed. Branding of young female seals, which will be begun after September 1st, will be carried on by Colonel Murray, chief agent on the islands, and E. F. Farmer, electrician. The skins of the branded cows which returned this year to the islands show clearly the permanency of the mark and its efficiency to render the skins unsalable, without injury to the animal or to the herd.

THE London *Times* has published a letter two and a-half columns in length from Mr. Herman Liebes, one of the lessees of the Prybiloff Islands seal rookeries, in which he presents the case for the United States in a temperate and reasonable manner, much more likely to prove convincing than the recently published letter of Secretary Sherman. The communication should make it clear to the ordinary reader that the decrease of the herd is not due to the loss of the seals killed on land, which are only young bachelors not serving harems, but to pelagic sealing, where at least 80 per cent. of those killed are females which are both pregnant and leave young to die of starvation on the islands. Since 1890 the annual catch of seals by the pelagic sealers amounts to an average of 88,916, as compared with an average of 15,770 from the islands.

THE MISSOURI GEOLOGICAL SURVEY.

THE following editorial comment appears in the *Journal of Geology:*

"The State of Missouri has recently had deep disgrace thrust upon it by the removal of the efficient director of the Geological Survey, and by the appointment of men to its care and conduct who possess, according to information that we deem trustworthy, not only no competency to perform their duties, but not even a plausible semblance of competency. These appointments have apparently no other motive than the conferring of personal or political favors. No causes of complaint, we are informed, were even alleged against the previous conduct of the Survey, or against the officials in charge of it. The scientific public has had ample demonstration of the vigor and energy with which the Survey has been prosecuted, the promptness with which its results have been published, and the adaptation of the work to the development of the economic as well as the scientific resources of the State. It appears, therefore, that the moneys appropriated by the State of Missouri for the laudable purpose of investigating and advertising its resources, and of informing its people concerning their own sources of material and intellectual wealth, are being virtually diverted from the purposes specifically indicated by the statutes of the State, and are being used for the personal and political interests of the Governor and his friends in the form of payment for worthless services. We are not sufficiently informed in the technicalities of law and the processes of the Courts to know how legal action in a case of this kind can be instituted and maintained, but if the appointees are as obviously incompetent as information indicates, they are simply consuming the funds of the State to no purpose save their own, and we think that an effort

should be made to procure a formal declaration by the Courts whether this is not a virtual embezzlement, and, if so, to secure the award of the proper punishment. If there is now no way of compelling a Governor to respect the laws of a State and the purposes of its statutes, a way should be provided."

GENERAL.

THE International Mathematical Congress, which closed its meetings at Zurich on August 11th, decided that its next meeting be held in Paris in 1900. A committee of five members was appointed to report on mathematical progress in different countries and to promote the establishment of mathematical departments in academic and other libraries. A resolution was passed favoring the institution of a central correspondence bureau in order to maintain closer relations between teachers and students of the higher mathematics in different countries.

THE attendance at the recent meeting of the French Association for the Advancement of Science at Saint-Etienne was smaller this year than usual, amounting to scarcely 400.

PRINCE LUIGI, of Savoy, and his party succeeded in reaching the summit of Mt. St. Elias at noon on July 31st. The altitude was determined to be 18,120 feet; no indications of volcanic action were found. It is said that the expedition under Mr. Bryant reached an altitude of 14,500 feet—the height reached by Professor Russell in 1891—and was compelled to return owing to illness.

IT will be remembered that Congress appropriated $5,000 for a continuation of the survey of the gold resources of Alaska, but the bill containing this item was passed too late to make it available this year. The expedition under Mr. J. E. Spurr will go next year, and it is proposed to ask for an increase of the appropriation to $25,000 in order that a complete survey may be made and a geological map of the region prepared.

PROFESSOR CORFIELD has been elected an honorary member of the Royal Society of Public Health of Belgium, of which he has been a corresponding member for some years.

PROFESSOR BELAJEFF has been appointed director of the Botanical Gardens in Warsaw.

IN addition to the degrees conferred on Lord Kelvin, Lord Lister and Sir John Evans by the two universities located at Toronto, McGill University will this week confer on them the doctorate of laws. The convocation of McGill University will be held in recognition of the meeting of the British Medical Association and will confer the degree on Dr. L. L. Barnes, President of the Association, and probably on others in attendance.

A SPECIAL number of the *Rendiconti della R. Accademia dei Lincei* announces, says *Nature*, the award of the following prizes, besides others for essays of a literary character: The royal prize for physics to Professor Adolfo Bartoli, of Padua, for his two monographs on the specific heat of water between the temperatures of 0° and 35°, and on the heat of the sun and for other investigations. For the ministerial prize for physical and chemical science eight competitors entered, and the judges have awarded a prize of 1,000 lire to Professor Carlo Bonacini, of Modena, for his essays on orthochromatic and color photography, and on the reflection and other properties of Röntgen rays; also awards of 250 lire each to Professor Carlo Cattaneo, of Turin, for his notes on the conductivity of electrolytes and on the velocity of ions, and to Professor Pietro Bartolotti for chemical investigations relating to the compound Rottlerine and other derivatives.

WE learn, with much regret, of the death of Professor J. E. Humphrey, which occurred about the middle of August at Jamaica, where he had charge of a biological expedition from the Johns Hopkins University. Professor Humphrey was a graduate of Harvard University and was a young man, having been promoted only last year to an associate professorship of botany at Johns Hopkins University. He had made important contributions to our knowledge of the algæ and in other directions, and was building up a strong department of botany in the Johns Hopkins University.

WE regret also to announce the death, at the early age of 23 years, of Mr. Joseph G. C. Cot-

tier, fellow of Columbia University. Mr. Cottier had been traveling in France since the first of July, and died from typhoid fever at Paris on the 17th of August. He was a student of exceptional ability in the mathematico-physical sciences and gave promise of a brilliant career.

THE deaths are also announced of Mr. Albert Marth, fellow of the Royal Astronomical Society and the author of many valuable contributions to astronomy, at the age of 69, and of Mr. S. E. Peal, of Assam, a writer on astronomical topics.

A CABLEGRAM to the daily press reports that the British steamer Windward, which left England on June 10th last, for Franz Josef Land, to bring back from the Arctic regions the members of the Jackson-Harmsworth expedition, who have spent three winters near Cape Flora, passed Aberdeen on Aug. 28th on her return trip and signalled that all were well on board. During the present summer the expedition was to make an attempt to reach the highest point north through an opening in Queen Victoria's Sea, the open water discovered by Jackson.

REUTER'S agency announces that M. Nossiloff, the explorer, has arrived at Tiumen from the Kara Sea. He has made important discoveries connected with intercourse between Siberia and Europe, especially a direct waterway which is considerably shorter than the old one and is not affected by the sea ice. M. Nossiloff also announces that he has investigated the hitherto unexplored Yalmal peninsula.

PROFESSOR W. W. CAMPBELL will have charge of the expedition of the Lick Observatory to India to observe the total eclipse of the sun on January 21st of next year. As we have already stated, this expedition has been made possible through the generosity of the late Col. C. F. Crocker.

THE Boston *Transcript* states that Mr. Edward Kemeys, the animal sculptor, will probably receive a commission for the decoration of the zoological park in Washington. It is proposed to decorate the park with bronze figures of Indians and wild animals, of life size or a little larger, to preserve the types of animal life which are rapidly vanishing. The Indians will be represented in some pieces as alone and in some pieces as riding or hunting the animals. The animals will sometimes be separate and sometimes grouped together, as in the case of a leopard killing a deer.

IT is reported that as soon as the new library of the Moscow University is completed, the well-known savant, Dr. Luginin, has promised to make it a present of his fine collection of books on chemistry, embracing 12,000 volumes, besides adding a sum of money for purchasing new books on that subject.

THE annual meeting of the corporation of the Marine Biological Laboratory at Woods Holl was held at that place on August 26th. The chief business was the election of a board of trustees and the enactment of some changes in the by-laws. Seventy members were in attendance. A resolution was adopted ratifying certain changes in the constitution proposed at a special meeting in Boston on August 16th. Among the more important amendments adopted were those providing that the number of trustees be increased from twenty to twenty-four, and that ex-officio members be made members of the board of trustees. Trustees were elected as follows: Clerk, Professor H. C. Bumpus, Brown University; Dr. E. G. Gardiner, Professor Clark, Williams College; Dr. J. P. McMurrich and L. L. Nunn, University of Michigan; Professor H. F. Osborn and Professor E. B. Wilson, Columbia; Professor William Libbey and W. B. Scott, Princeton; Professor W. C. Sedgwick, Massachusetts Institute of Technology; Professor Sydney W. Smith, Yale; Dr. William Trelease, Missouri Botanical Gardens; Professor W. P. Wilson, Philadelphia Museum; Professor B. Ramsey Wright, University of Toronto; Professor J. M. McFarlane and E. G. Conklin, University of Pennsylvania; Professor E. P. Mall, Johns Hopkins University; Professor E. L. Mark, Harvard; Samuel P. Scudder, Cambridge; Lawrence Minot, Boston; Professor T. H. Morgan, Bryn Mawr; C. G. Kidder, New York; Professor M. M. Metcalf, the Woman's College of Baltimore; Professor William Patten, Dartmouth; Professor D. P. Penhallow, McGill University.

Nature learns from the *Brisbane Courier* that Hon. R. Barr-Smith, of Torrens Park, South Australia, has offered to subscribe the amount

necessary for the establishment of a tentative meteorological station at the summit of Mount Kosciusko, in the southeastern extremity of Australia, at a height of about 8,000 feet. Mr. Wragge hopes that the comparison of the results with those obtained from low-level stations will insure a permanent observatory being established in the interest of Australasia.

M. JANSSEN was expected, says the Paris correspondent of the London *Times*, to leave Paris on August 21st to inspect his Mont Blanc observatory. The scientific caravan will start from Chamonix at the beginning of September to take meteorological readings at an altitude of 14,000 feet, the highest station in the world, and to study solar radiation. M. Perrotin, director of the Nice observatory, will, it is said, join the party in order to study the morning elongation of Venus and to ascertain the period of the planet's rotation. Foreign men of science wishing to make the ascent will enjoy the hospitality of the establishment.

AT the monthly general meeting of the Zoological Society of London, held on August 19th, at their offices in Hanover-square, it was stated that the number of additions to the Society's menagerie during the month of July had been 102, among which special attention was called to a young pair of Babirussas (*Babirussa alfurus*), from Celebes, presented by the Duke of Bedford; to an example of the thick-billed penguin (*Eudyptes pachyrhynchus*), from Stewart Island, New Zealand, deposited by the Hon. Walter Rothschild; and also to a very large example of Daudin's tortoise (*Testudo daudini*), deposited by the same gentleman. The President delivered the silver medal of the Society to Mr. Alexander Whyte, F.Z.S., in acknowledgment of the valuable services he had rendered to zoological science by the large collections he had made in every branch of natural history in British Central Africa, while acting as chief scientific officer to Sir Harry Johnston.

THE second International Conference on Railway and Marine Hygiene will, as we have already announced, meet at Brussels on September 6th, 7th and 8th. Several governments and societies have appointed official delegates, and numerous papers have been promised. There will be three sections: (1) Organization of the Medical Services; (2) Guarantees of Personal Fitness; (3) Hygienic Rules and Regulations. The officials and medical officers of foreign railway companies can obtain free passes upon the Belgian state railways. Dr. J. De Lantsheere, 56, Rue de l'Association, Brussels, will supply further information.

THE British Pharmaceutical Conference, which has recently concluded its sessions at Glasgow, will next year meet at Belfast, Dr. Symes, of Liverpool, being reelected President. One of the more interesting papers presented to the Conference was by Professor Atkinson, of London, showing that the people of Great Britain expend annually £3,000,000 on patent medicine. In 1872 the annual revenue from patent medicine stamps was £82,000; ten years later that amount was doubled, and in 1892 the tax produced £240,000. He thought that the government should exercise more control over the sale of these secret nostrums.

THE *Progrès médicale* publishes a somewhat extended account of the International Bibliographical Conference which met in Brussels on August 2d, 3d and 4th. A special discussion took place on the Dewey decimal system of classification, which was opposed by M. Funck-Brentano and defended by M. Baudouin and others. Dr. Haviland Field announced that the delayed *Concilium bibliographicum* for zoology would soon begin the issue of cards. M. Baudouin stated that within three years nearly 200,000 bibliographical cards with analyses, relating especially to the biological sciences, had been prepared for the Paris Institute of Bibliography.

MR. MOSES P. HANDY, special commissioner to the Paris exhibition of 1900, has gone to Paris to make arrangements for the space and location of exhibits from the United States. He is reported to have said before leaving that he thought 500,000 square feet of space would be required by American exhibitors, or more than four times as much as was in the exposition in 1889. The exhibits in electrical and railway appliances are expected to be especially complete. A thorough educational exhibit will also be prepared.

THE exhibition now open at Brussels contains a feature of interest to anthropologists. Two hundred natives of the Congo tribes have been brought from Africa and are exhibited in a replica of a Congolese village. The greater number are Batatelas, but other tribes are represented, including two of the forest dwarfs described by Stanley.

THE first number of the *Zoological Bulletin*, edited by Professors C. O. Whitman and W. M. Wheeler, of the University of Chicago, has now been published by Ginn & Co. The title page gives the names of seventy-three American students of the zoological sciences who have given their cooperation. This number contains articles by Edward Phelps Allis, Jr., on 'The Morphology of the Petrosal Bone and of the Sphenoidal Region of the Skull of Amia Calva;' by Charles W. Hargitt on 'Recent Experiments on Regeneration;' by Charles Lawrence Bristol on 'The Metamerism of Nephelis,' and by G. Baur 'On the Question of Intercalation of Vertebræ.' The number extends to fifty-three pages and it is expected to publish at least six numbers of this size yearly. The *Bulletin* has the same form and size of page as the *Journal of Morphology*, and will apparently differ from that journal only in that the articles will be as a rule shorter and not illustrated.

A QUARTERLY botanical journal, entitled *Bollettino del Reale Orto Botanico di Palermo*, will hereafter be published, under the editorship of Professor Borzi.

HENRY HOLT & Co. announce for early publication 'The Elements of Comparative Zoology,' by Professor J. Sterling Kingsley, of Tufts College; 'Laboratory Directions in General Biology,' by Harriet Randolph, instructor in Bryn Mawr College; an 'Outline Introductory to Kant's Critique of Pure Reason,' by Professor R. M. Wenley, of the University of Michigan, and a new and much enlarged edition of Hall and Bergen's 'Text-Book of Physics.'

WE are glad to note the full reports in the American daily press of the recent meeting of the British Association at Toronto, even though some of these papers did not mention the meeting at Detroit. We hope that all the papers will remember next year that there is an American Association for the Advancement of Science.

THE fourth International Scientific Congress of Catholics opened its sessions at Freiburg, Switzerland, on the 15th of August. Mgr. Dernaz, Bishop of Lausanne and Geneva, was the president of honor, and Baron Hertling, professor of philosophy in the University of Munich, was made president of the Congress. The Congress met in ten sections, and there were 500 members in attendance.

THE *Engineering News* Publishing Company have republished three articles on the floods of the Mississippi River contributed to the journal in the course of the past two years by Mr. William Starling, Chief Engineer of the Lower Yazoo Levee District. The articles describe the levees of the Mississippi river and the floods, especially that of 1897, and should prove useful in disseminating knowledge of the cause of the floods and the proper means to be used in combatting their ravages.

THE *Electrical World* reports a paper by M. Pierard describing an application of the phonograph in Spain. It appears that the telephone is there used in place of the telegraph, and it was found that the speed of transmission was greatly limited by the operators at the receiving end, who could not transcribe the messages sufficiently rapidly; at present the receiving operator repeats the message into a phonograph, from which it is then transcribed; this repetition is also heard at the transmitting end and therefore serves as a control for the correctness of the received message; the speed is 86 words per minute, which means double this amount if the return message is included. It is thought that this is the first time the phonograph has been put to this use.

A BRITISH Parliamentary paper has been issued given a report of the efforts to check the locusts in Cyprus during the past year. The High Commissioner, Sir W. J. Sendall, states that the system of purchasing eggs and living locusts, which has now been pursued for four years, has appreciably diminished the number of locusts.

THE first quarterly report, says the New

York *Medical Record*, since the appointment of medical inspectors of schools in this city has been made by Dr. Blauvelt, the chief medical inspector. The report includes a table showing the different kinds of diseases for which children were excluded from the schools. Parasitic diseases of the head appear to have been the most prevalent, 2,627 cases having been discovered among the children examined. Contagious diseases of the eye come next on the list, over 700 cases being reported. Skin diseases claimed 175 victims, and diphtheria 91. Measles was responsible for the exclusion from school of 51 children, and 20 cases of genuine scarlet fever were discovered. Croup was of comparatively rare occurrence, but 26 scholars were compelled to forego school attendance for a short time on account of whooping-cough. The report gives the number suffering from mumps as 117, and from chicken-pox as 93.

IT appears from an article in *Machinery* that the Stockholm Exhibition, which has attracted but little attention in the daily press, is of considerable scientific interest. The exhibition grounds cover an area of about 220,000 square yards—a space which is about doubled if the mountain plateau, which is given up to a realistic reproduction of Swedish country life from the Laplander's hut to the thriving farmer's homestead, with all the fauna and flora of the country, is added to it. The most imposing building in the grounds is the Industrial Hall, which is said to be the largest wooden structure in the world, a forest of about 34,000 trees having been used up in its elevation. The exhibits in this building are selections from the ordinary products of the industries of Sweden, Norway, Denmark and Russo-Finland. Not far from it is the Machinery Hall, and in close contiguity are mining exhibits, forest exhibits, electric works and numerous private pavilions illustrative of the industrial works of the country.

PROFESSOR RAPHAEL MELDOLA writes to the London *Times* regarding the case of death from an inflammable hair wash which has excited much discussion in Great Britain. "It is, of course, well known to those who are in the habit of dealing with low boiling-point liquids giving off inflammable vapors, such, for example, as ether, that the presence of a naked flame, even at a distance of many yards, is attended with great danger. But in the present case Professor Meldola corroborates by personal experience the contention of Lord Kelvin that an electric spark, although in itself feeble, is quite sufficient to ignite an explosive mixture of hydrocarbon vapor and air. Some years ago he was consulted by a manufacturer who had an extensive business in what is called the 'dry cleaning' of wearing apparel. In this process the goods, previously well dried, are immersed in a vessel of benzine, in which they are kept in motion by means of mechanical stirrers. In spite of every precaution to insure the absence of naked flames in the building in which the operation was conducted, fires were constantly occurring, and at one time the process threatened to become a failure on account of this apparently spontaneous inflammability of the hydrocarbon vapor. It was only when the possibility of the generation of electricity and the passage of sparks were suggested that precautions were taken to exclude air from the upper portions of the vessels and that the process became practicable. The experience afforded by this process points most conclusively to the correctness of the electric spark theory of the ignition, and on this ground alone the use of such inflammable hydrocarbons for cleaning the hair—apart from the very doubtful question of their efficacy—should be absolutely condemned."

THE Executive Committee of the International Medical Congress has followed the example of its predecessors at earlier gatherings in publishing descriptions of the medical institutions of the country. The *British Medical Journal* gives an account of one of these, containing a full description of the medical societies of Russia. The oldest Russian medical society was founded in Moscow in the year in 1804, and is still in existence. It is attached to the University of Moscow, and is known as the Physico-Medical Society. A year later the Vilna Medical Society was instituted; it also still exists, but owing to the chequered career of the University of Vilna (which was removed to Kief after the Polish rising of 1833) this society has lost something of its former prestige.

The institution of these two societies was almost coincident with the opening of the three Universities of Kharkof, Kazan and Vilna by the Emperor Alexander I. Before his reign there had been but one university in the Empire, that of Moscow. Towards the close of his reign, in 1819, still another university, that of St. Petersburg, was opened; and in the same year the Society of German Practitioners in St. Petersburg was formed. This was followed a year later by the formation of a similar society in Warsaw. A gap of over thirty years, corresponding to the reign of the Emperor Nicholas I., succeeded, during which but one medical society was instituted in Russia. This was the Society of Russian Practitioners in St. Petersburg. From the date of the accession of Alexander II. the number of these societies has rapidly increased. There are now no fewer than 120 in the whole of the Empire, the total capital of which amounts to over $600,000. The majority of Russian medical societies have libraries attached to them; while some have museums, laboratories and even free dispensaries.

UNIVERSITY AND EDUCATIONAL NEWS.

It is announced that M. Eulogius Georgieff, the founder of the Sofia University, who died recently, bequeathed 20,000,000 fr. to the Bulgarian government for public purposes, including 6,000,000 fr. for a technical school to be established at Sofia.

Mr. S. B. Brownell has presented Barnard College, New York, with a building for a dormitory to cost $150,000, which will be erected at once.

The endowment left by Patrick B. O'Brien, of New Orleans, for establishing chairs of chemistry, of physics and of Roman law in the Catholic University of America will be available this autumn. The Rev. Father W. J. Kirby has been appointed professor of sociology.

A committee of the Trustees of the University of Missouri has been appointed to investigate the political views of Professor C. H. Hicks, since 1892 professor of political economy in the University. The report of the committee will probably result in the removal of Professor Hicks, and it is said that Dr. W. G. Brown, professor of chemistry, is likely to share the same fate.

The Council of the University of Lyons has devoted the sum of 42,000 fr. to complete the construction of the laboratory of biology of Tamaris, near Toulon, and it is expected that a sum will be appropriated to the support of the laboratory.

The School of Applied Chemistry, founded last year under the auspices of the faculty of science of the University of Paris, has celebrated its first anniversary. M. Darboux presided, and an address was made by M. Friedel, director of the laboratory.

The University of Berlin offers holiday courses for teachers of science in the higher schools from the 29th of September to the 9th of October of the present year. Lectures will be given by Drs. van't Hoff, Dames and other leading professors, and excursions and visits of scientific interest have been arranged.

Dr. Kihlman has been appointed associate professor of botany in the University at Helsingfors. Dr. Theodor Petersen and Dr. Josef Epstein, of the Physical Institute of Vienna, have been appointed to professorships. Mr. Stanley Dunkerley, of the department of applied mechanics, Cambridge, has been appointed professor of applied mechanics at the Royal Naval College, Greenwich.

DISCUSSION AND CORRESPONDENCE.

'THE PRESENT EVOLUTION OF MAN.'

In Science of July 2d, pp. 33–35, Professor T. D. A. Cockerell published a kind and appreciative review of my book 'The Present Evolution of Man,' for which I am more than grateful. He disagreed with me, however, as to several matters, and as on these precisely I have failed to carry conviction to many critics I am forced to believe either that I am wrong or that my explanations have not as yet been adequate nor sufficiently clear. I would fain hope the latter, and therefore am glad to seize the opportunity Professor Cockerell's review affords of making some reply in the pages of Science.

Professor Cockerell does not entirely agree with my theory of retrogression. Put very

briefly, that theory is as follows: It is known that the ontogeny recapitulates the phylogeny, though in a rapid, blurred and indistinct way.* In other words, almost every individual recapitulates the traits of all his ancestors, beginning with those of the first (as, for convenience, we may call the unicellular organism) and ending with those of the last. I use the word 'almost' because, though the earlier stages must, of course, be recapitulated, for otherwise the individual would not develop, yet sometimes (indeed often) the very last steps made in the evolution of the race fail to be reproduced by the individual in his development. He then resembles some remote ancestor more than he does his parents, and presents, in fact, an example of what is known as atavism. When the evolution of the race has been rapid, reversion to any given ancestor results, of course, in a much greater and more observable degree of retrogression than when the evolution has been slower, and therefore, while offspring of race horses often exhibit far-reaching reversion towards the ordinary horse, and while the seedlings of various garden plants (apple, peach, rose, etc.), which have been evolved under excessively stringent selection, generally revert to the ancestral type, the offspring of wild plants and animals generally 'breed true.'

An individual may vary from his parent in two ways—towards the ancestry when some of the last steps made in the phylogeny are omitted in his ontogeny, or away from it, the former variation being atavistic, the latter evolutionary; and so far as we are aware the chances of his doing the one or the other are equal. But while every variation towards the ancestry, that is, every failure to repeat in the ontogeny the last steps made in the phylogeny, produce atavistic retrogression, every variation from it need not be an extension of the previous evolution; it may constitute a reversal of it (as will be seen presently) or be in some other different direction, whence it follows that in the absence of selection a species must always undergo retrogression.

Up to this point, or nearly up to it (for as to this I am not very clear), my critic and I seem to be in agreement; but beyond this we differ, for while he thinks that such atavism can result in very limited retrogression only, I am of the opinion that in the entire and continued absence of selection it must result in absolutely unlimited retrogression. Before dealing with his objections I ought to say that in my book I quite reject the Lamarckian doctrine of the transmissibility of acquired traits, and since Professor Cockerell is good enough to say that he regards the arguments there used as conclusive, the matter is not in dispute between us. Moreover, he seems to agree with me in attributing evolution to the accumulation of small 'normal' variations, not to the accumulation of great and abnormal variations, for the reason that the latter tend to be swamped, owing to their infrequency. I should also make it clear that by atavism I do not necessarily mean atavism of the whole organism. Such wholesale reversion to the ancestral type must be extremely rare in the case of all species slowly evolved under the ordinary conditions of nature; it occurs only, so far as I am aware, in such species as have evolved under very stringent artificial selection. Under natural conditions an individual may exhibit evolution in some particulars and atavistic retrogression in others, but these latter, owing to the slowness of the antecedent evolution, must generally be minute in amount, and, therefore, when associated with evolutionary changes, unrecognizable in the individual, though recognizable after the lapse of generations in a line of individuals. Thus, while selection may result in evolution in the legs of a bird to which flight has become useless, atavistic reversion in the absence of selection as regards them would result in the retrogression of its wings. But here again, the wings, being complex organs, would not equally retrogress in all their parts, and, therefore, would never very closely approximate to the ancestral type.

Professor Cockerell says: "I cannot see, with Mr. Reid, that there would be unlimited atavism, because when the atavistic changes had proceeded from B to A *the B features would become ancestral* and a new atavism from A to B would appear." (The italics are mine.) It is

*I have given reasons why the recapitulation is blurred and indistinct, but these need not detain us here.

this sentence which leads me to suppose that I have not adequately explained myself, for clearly Professor Cockerell does not understand my theory as I understand it. Supposing, as regards any character, A B C D represent a line of individuals, then, if D reverts to B, that is, if D varies from C so that in his ontogeny he repeats the life history of the race only up to the point reached by B, omitting the additional characteristics of C, my contention is that C disappears altogether from the series, which, from the point of view of heredity, becomes A B D and, therefore, if the characters of C ever reappear in E, or any subsequent member of the series, they must do so (as they did in C's case) as a result of evolution (variation away from the ancestry), not as a result of retrogression, of atavism (*i. e.*, variation towards the ancestry).* To test the truth of the theory we must consider a species in which evolution has been very rapid, as in that case atavistic changes can easily be observed with comparative ease; for example, any one of the various garden plants which are propagated by means of slips, it being probable that but a few seminal generations intervene between these widely divergent types and the ancestral wild varieties. The seeds of such a cultivated plant usually give origin to plants, which, in the great majority of instances, resemble much more nearly the wild than the cultivated variety. Now, if Professor Cockerell is right, the continual seminal propagation of such reverted plants should often result in a 'reversion' to the cultivated type; whereas, if I am right, this 'reversion' should never occur, since (for purposes of heredity) the cultivated variety has been eliminated from the ancestral line. Such reappearance would purport, therefore, not reversion, but a fresh evolution, which evolution would be too great to be accomplished in a single generation. So also the race horse, in the absence of selection, would revert to the ordinary horse, after which a race horse should be as rare among the progeny as it is at present among the progeny of ordinary horses.

It follows as a logical conclusion from the foregoing that cessation of selection, as regards any structure or character, during unlimited time must result in unlimited atavism. First recent ancestors would be approximated to, then ancestors more remote, and lastly that remote ancestral condition when the structure or character did not exist. It would then disappear as utterly as have done, from this cause, the limbs of serpents. In fact, atavism effects the same result as disuse is said to do by Neo-Lamarckians, and, unless we accept the Lamarckian doctrine, I confess I am unable to perceive any other probable reason for retrogression.

Professor Cockerell further writes: "The germ, it must be supposed, contains units representing many phases of existence, while others are new. When one of the latter develop we say the variation is a progressive one; when the former develop we call the result atavism. It is reasonable to suppose that environmental and germinal selection are the factors which determine which of its possible developments the germ shall undergo." Here, again, is proof that I have not made myself clear on this point to Professor Cockerell. He has been kind enough to speak with some approval of my theory, but he has not perceived that it is absolutely incompatible with the theory of germinal selection. Surely in the present state of our knowledge it is too much to affirm that the germ *must* contains *units* 'representing phases of existence.' During the ontogeny many phases of existence are represented in fleeting but orderly succession, but again, surely it is not essential to suppose that the development of each is due to one or more *units;* and, moreover, does not the regular recapitulation of the phylogeny during the ontogeny negative the idea that any 'units' are 'held over?'

I must be brief in my comments on the rest of Professor Cockerell's review. He says that in considering man's present evolution I have neglected to take into account what Mr. B. Kidd has called 'social efficiency.' If he turns to my work (pp. 178–200) he will find that I have not altogether neglected the matter. Briefly, I have attributed differences in social

*For the sake of simplicity I do not here consider such a case as when D repeats the life history up to C and *then* reverts *back* to B, but it is dealt with to some extent in my book, and the process is of importance when considering the phenomena connected with 'reversed selection.'

efficiency to differences in acquired mental characters, that is, to differences in education. Mr. Kidd attributes social efficiency, which he derives from the greater or lesser development of the altruistic feeling, to natural selection; but natural selection implies elimination of the unfittest, and he has failed to record a single death as due to the absence of this feeling in him who perished and the presence of it in him who survived. If it be maintained, as is sometimes done, that 'social efficiency' has been evolved, not through selection of individuals, but through selection of communities, then I can only say that such a contention appears to me to involve a complete misconception. Evolution can result only from the selection of individuals, never from the selection of communities; except, indeed, in the case of such communities (*e. g.*, ants, bees, terits) as are the progeny of a single pair of individuals, when the parent individual is selected in the person of the progeny. Supposing a superior community (of men, for instance), without individual selection within itself, causes the elimination of an inferior community, then, as a consequence, the former spreads, but does undergo evolution. Its superiority (if inherent, and not acquired) arises from an antecedent selection of individuals within itself. Professor Cockerell says that sanitary arrangements 'do select the citizens of one town, state or country as against others, or those of the rural districts as against the towns.' But surely sanitary arrangements do not come under the head of human evolution, but under what has been called 'Evolution in the Environment.' The knowledge of it is acquired. If New York now values sanitation more than it did fifty years ago, or more than Baltimore does at the present time, is this not due, beyond doubt, to a difference in education (*i. e.*, acquired mental characters), not to an inborn intellectual difference?

I now come to the last of Professor Cockerell's objections and I wish exceedingly I had more space to deal with it. I have shown that certain powerful narcotics (*e. g.*, alcohol and opium) are great causes of elimination; that races (*e. g.*, Greeks, Italians, South Frenchmen, Spaniards, Portuguese) which have long possessed a cheap and abundant supply of alcohol, for instance, are the least prone to excessive indulgence of all races on earth; that other races, (*e. g.*, Anglo-Saxons, Scandinavians, Russians, etc.), which have had a less extended experience are more prone to intemperance; that yet other races (*e. g.*, savages of all kinds, whether inhabiting the frigid, the temperate or the torrid zones), who have had little or no experience of alcohol, crave for that narcotic so intensely that, in the presence of an abundant supply and the absence of prohibitory laws, they perish of excessive indulgence; and have argued, firstly, that the craving for narcotic indulgence was inborn in man as a by product of mental evolution;* secondly, that the Italian, for instance, is more temperate than the American Indian, as a result of natural selection, *i. e.*, alcoholic selection; and thirdly, that to render a race more temperate we must eliminate, not drink, but the excessive drinker, for compulsory temperance must lead to the survival of the unfit and consequent retrogression of the race to the ancestral type, when the craving was stronger than it now is in a race which has undergone alcoholic selection.

Had I proved my facts and used this line of argument as regards any physical structure I think all the world would have agreed with me; but, because I dealt with the burning question of intemperance, I have met with numerous objectors ranging from a clerical gentleman, who found distinct points of resemblance between Satan and me, and argued that, *therefore*, my theory 'must be a lie,' through Professor Ray Lankester, who, while admitting the truth of the theory, apparently thought that a tendency to get excessively drunk might be necessarily correlated to extremely valuable quali-

* Just as the paresis which accompanies excessive fear is inborn, *e. g.*, in frog when attacked by snake, as a by product, a correlated variation, of the life saving faculty of fear. Of course, I do not mean that an American Indian, for instance, who has never tasted alcohol, craves knowingly for it; I merely mean that he has an inborn love for such feelings as are induced by deep indulgence, just as he has an inborn love for such feelings as may be induced by eating a delicious food. Till he tastes a peach, for instance, of course he does not knowingly crave for it, yet nevertheless the love for the peach is born and in like manner is that for alcohol.

ties, up to Mr. Alfred Russell Wallace and to Professor Cockerell, who thinks "that the human race has no natural craving for alcohol at all, but it has a craving for excitement and other states of mind which may be induced artificially, and that when the natural exercise of highly valuable faculties is denied, as is so often the case in our present civilization, artificial means, often highly injurious, will be resorted to." But it is the absolute savage who is most prone of all races on earth to excessive indulgence, and surely, living, as he does, in a 'state of nature,' the natural exercise of 'highly valuable faculties' is not denied to him. Moreover, if Professor Cockerell is right, what is the difference between the civilization of the South and North of Europe, which permits in the former case the natural exercise of valuable faculties, but forbids them in the latter, for the north Europeans are much more drunken than the south Europeans.

Let the reader think awhile. Why does he not get drunk? Is it because he constantly resists the craving, or because the craving does not exist in him? I think he will say, 'the latter.' But has he no acquaintance, reared and living under much the same conditions, who drinks, to excess, though all his interests call him to abstain? I think he is sure to have such an acquaintance. Now, in this respect nations like the Italians or the Spaniards are mainly composed of individuals like my reader, while nations like the American Indians or the native Australians are mainly composed of individuals like his unfortunate acquaintance.

Here is a significant fact: old records seem to prove that the classic races were anciently much more intemperate than at the present time. For instance, the temperance question was formerly a burning one in Greece, where unhappy Helots were made to furnish 'awful examples' to the aristocratic youth. Here is another: the deadly narcotic opium has been in use for some hundreds of years in India, and never or very rarely does a native of that country take it to excess; it has been in use for about two hundred years in China, and most of the Chinese are temperate, though some take it to excess; it has been recently introduced into Burmah, and, practically speaking, all Burmans take it to such excess that they perish of it, and, therefore, in their own country the English have forbidden the use of opium to Burmans alone, while permitting it to all other peoples, just as in Canada alcohol is forbidden to the aborigines alone. Here is a third: tobacco causes little or no elimination, and, therefore, the craving for it is as strong in races that have longest used it as among races to which its use is comparatively strange.

G. Archdall Reid.

Louthsea, England.

AMPHIBIA OR BATRACHIA.

Professor Burt G. Wilder has made some remarks in the last number of Science (August 20, 1897) about the French word *Batraciens*. He says: "Dr. Baur shows that the French word *Batraciens* was applied to the frogs, toads and salamanders by Brogniart in 1799, and that the Latin forms *Batrachii* and *Batrachia* were not introduced until 1804 and 1807, by Latreille and Gravenhost. But does not Dr. Baur lay undue stress upon the distinction between the French and the Latin form? *Batraciens* is not (like *crapaud*, etc.) a vernacular word; it is the French form, or, galloparonym (!), of the Latin *Batrachia*, and the employment of the former would seem to constructively sanction the use of the latter." Professor Wilder 'as a teacher of zoology, but without claim to expert authority upon taxonomic points,' seems to be absolutely ignorant of the fundamental rule in nomenclature (published in all Codes of Nomenclature), that all vernacular names, of genera, families, orders, classes, even if formed from a classical root, are never accepted. Such vernacular names have especially been used in France by Cuvier, Lesson, de Blainville and notably other French writers of the early part of the present century. Such names have in many cases been later adopted into the science under a proper classical form, and should take date only from this later introduction. I should like to recommend to Professor Wilder the study of 'The Code of Nomenclature adopted by the American Ornithologists' Union, 1892.' This code is followed by all American naturalists. The case of *hippocampus* referred to by Professor

Wilder has nothing to do with zoological nomenclature.

G. BAUR.

THE SOURCE OF METENCEPHALON AND OTHER LATIN NAMES FOR THE SEGMENTS OF THE BRAIN.

TO THE EDITOR OF SCIENCE: In my paper, 'The definitive encephalic segments and their designations,' read before the Association of American Anatomists last May, were offered objections to the action of the Anatomische Gesellschaft* in designating the region between the cerebellum and the myel (spinal cord), not by *metencephalon*, as in the last three editions of Quain's 'Anatomy,' but by *myelencephalon*. This last was proposed by Owen for the entire neuron (central nervous system) in 1866 or earlier, and, so far as I know, its application to a single segment was made by Huxley in 1871. Before printing the paper above named, I desire to ascertain when and by whom that region of the brain was first called metencephalon; incidentally, also, the source and date of the other words, *prosencephalon*, *diencephalon*, *thalamencephalon*, *mesencephalon* and *epencephalon*, that have been offered as equivalents for von Baer's names, *Vorderhirn*, *Zwischenhirn*, *Mittelhirn*, *Hinterhirn* and *Nachhirn*. Information through your columns or directly will be very welcome.

BURT G. WILDER.

ITHACA, N. Y.

*His. W. Die Anatomische Nomenclatur. *Archiv. für Anat. u. Physiol.*, Anat. Abt., Supplement-Band, 1895, p. 156.

ANDRÉE'S NORTH POLE BALLOON VOYAGE.

IN SCIENCE for August 20th, p. 291, occurs a copy of a telegram purporting to come from Dr. Nils Ekholm regarding the Andrée balloon which is attracting so much attention. One serious error in the transcription should be corrected. It is stated that the balloon at the start rose to a height of 15,000 to 25,000 ft. The original may have been 150 to 250 metres (490 to 820 ft.), but could not possibly have been as given. To ascend 25,000 ft., over 3 tons of ballast would have to be thrown out, and this, of course, is not thinkable. At 25,000 ft. two-thirds of the gas would have been lost and the voyagers would have been in great danger of freezing to death.

It is a little difficult to understand Dr. Ekholm's figures. Admitting that 1,800 cubic feet of gas leaked out each 24 hours, entailing a loss in buoyancy of 123 pounds, as he gives it, there should still be enough gas for over 70 days, instead of 22 to 24 days, as given. A leakage of 1,800 cubic feet would be about 1%, which is not excessive, though about 2 times as much as was expected. There are very few balloons built that have a leakage less than 3%. The very best 'cæcum' balloons ever made have a leakage of ½% in 24 hours. The total buoyancy of the gas was 12,000 pounds. The 3 men would weigh 500 and the balloon probably not over 1,700 pounds. Very tight balloons have been made in this country that would weigh for the same size about 900 pounds. This would give 80 days' flotation. It is probable that the computation calls for even a heavier balloon and also for carrying the car all the way. It is customary, however, to prepare the car so that it can be used as ballast and at the last use the ring of the balloon.

It is a great pity that more experience was not gained in a long voyage before attempting the extremely hazardous voyage to the Pole. The fact that the balloon was beyond control at the very start is very significant. It is doubtful if any aëronant living can release safely a balloon of 170,000 cubic feet capacity in a twenty-five-mile wind. Those who were present at St. Louis on June 16, 1887, will remember the extreme difficulty experienced in sending off the World balloon 160,000 cubic feet in a twenty-mile wind.

If plans had been made to keep the balloon at 6,000 feet or so the success of the voyage would have been better assured. By using a small pilot balloon it would have been easy to send the overflow into the smaller balloon and, after the larger had leaked out enough, the gas in the smaller balloon could have been sent into the larger and the smaller used as ballast. At 6,000 feet the danger of rain and sleet freezing on the balloon would have been avoided and the currents which are far steadier and more rapid would have reduced the voyage by

one-half or even one-third. It is not generally known that this country holds the record for a long-distance voyage.

On July 1, 1859, La Mountain and three others sailed from St. Louis, Mo., to Henderson, N. Y., 870 miles in nineteen hours. Such constancy and velocity of air currents is seldom thought of and could have been found only, as in this case, at a height of 6,000 to 8,000 feet.

The balloon route would seem the ideal method of reaching the Pole and the French are already planning for such a voyage in 1898. Let them first bring their balloon to this country and make the Atlantic voyage in the track of steamers where the least untoward event will not be absolutely fatal. Also, by all means, let the balloon be placed at a height of at least 6,000 feet. It is just as easy to keep a balloon there as close to the earth. At Mt. Washington (6,300 feet) there have been frequent cases of west winds of 100 miles and over per hour for 36 hours, and this would mean less than 40 hours for the trip.

Of course, the great question is as to the occurrence of storm and high-area conditions at the Pole similar to those in more southerly latitudes, and the evidence from weather maps made near the Pole seems to show a great similarity. If so, any steady wind near the Pole would give a straight course to the Pole and the same wind would give a straight course back to civilization. It is a pity that with so much interest centered in this enterprise there should be so many fakes of carrier pigeons, etc., started. It is very rare, indeed, that a carrier has been known to fly 1,000 miles and then only after being taken over some part of the course half a dozen times. For a carrier to go 1,500 or 2,000 miles is an unheard-of feat.

H. A. Hazen.

August 21, 1897.

SCIENTIFIC LITERATURE.

Agriculture in Some of its Relations with Chemistry. By F. H. Storer. New York, Charles Scribner's Sons. 1897. Pp. 1901. $5.00.

The new edition of Storer's 'Agriculture' is in three volumes; it is accompanied by a very full and well-arranged index, which adds to its value as a reference work. The author is modest in his title, for not only is agriculture dealt with in its relations to chemistry, but very largely in its relations to the allied sciences, physics, physiology, botany and zoology.

For example, the contents of Volume I. include thirteen chapters, and in the first six the relations of physics and plant physiology to agriculture are discussed quite as fully as are the relations of chemistry in the remaining chapters. In Chapter III. 'Relations of Water to the Soil' is discussed, and in Chapter IV., 'Movement of Water in the Soil;'' Chapter V. is devoted to a study of the principles of 'Tillage,' and Chapter VI., 'Implements and Operations of Tillage.' In these branches chemistry is not the primary science involved. In Chapter I. 'The General Influence of Soil and Air to the Plant' is treated, and in Chapter II., 'The Atmosphere as a Source of Plant Food.' In the discussion of these subjects the importance of the relations of plant physiology are fully recognized.

I note the above in order to show the general scope of the work; it is not limited to a setting forth of the relations of chemistry, as it could not well be and give a broad view of scientific agriculture.

That the author regards the question of manure to be of very great importance is shown by the elaboration of the various topics entered into, especially concerning the sources of supply, the modes of action and methods of using the various products. Seventeen chapters, seven in Volume I. and ten in Volume II., aggregating over 750 pages, are devoted to this one branch of scientific agriculture, and in which chemistry *is* the primary science involved.

His method of treating of the artificial fertilizers is worthy of particular mention. Not only is the theoretical consideration concerning the composition and character of the various fertilizing materials and their modes of action given, but numerous experiments from leading authorities are cited, thus putting before the student the original source of the information; a point often greatly desired by those who have not had a broad training in these lines, and

are thus not fully acquainted with the literature of the subjects involved.

Particular attention should also be called to Chapters XVIII., XXVI. and XXVII., concerning 'Humus or Vegetable Mould,' 'Lime and Lime Compounds,' and 'Sodium Compounds.'' It is eminently desirable that the information given in these chapters should be more generally disseminated, in view of the useless dissertations on these subjects by irresponsible writers. Humus, particularly, is an engaging topic for discussion by those who do not understand what it means. The same is true of lime—fruitless discussions are entered into, largely because of the lack of knowledge concerning the principles involved. So, too, with the matter of sodium as a fertilizer; papers teem with articles that are calculated to lead astray rather than to fix valuable truths in the mind of the farmer. Such articles also seem to possess a peculiar attraction for the general reader, and the result is 'confusion worse confounded.'

In Chapter XV. of Volume II. the subject of 'Symbiosis, or Blended Growth,' is discussed in the light of the recently acquired facts concerning this very important subject

That the legumes may and do, under proper conditions, use atmospheric nitrogen, is one of the most important recent discoveries in agricultural science, and the matter in its scientific and practical relations is fully and clearly set forth.

Volume III. contains fourteen chapters. It treats more particularly of 'The Theory and Practice and Systems of Crop Rotations,' the principles involved in and the advantages of 'Irrigation,' 'The Use of Sewage,' and 'The Growth and Management of Cereal Crops,' hay and pastures and the 'Making of Silage.' In the handling of these subjects, not only are the principles of chemistry as applied to agriculture well traced and made plain, but important practical suggestions are made concerning the economical principles involved in the general management of farms and in the growth of the various crops. The chapter on irrigation, while written from 'the point of view of a New Englander,' is, in view of the necessity of fully utilizing the natural advantages of the East, very timely, since it calls attention to the subject and points out conditions which are necessary for successful irrigation. Much of historical interest is included, also. The chapter on 'Ensilage'—it should be 'Silage'—is also up-to-date and includes much of value not otherwise readily accessible.

On the whole, the work may be regarded as of very great value to students and farmers alike, and should be in the library of every progressive man. The reader or student who takes up these volumes cannot fail to be impressed not only with the vastness of the subject included under the title 'Scientific Agriculture,' but also with the very great necessity to farmers of the present day of a knowledge of the principles upon which agriculture is based.

It may, perhaps, seem strange to the average person, that so little of the work of American investigators is cited by the author, for, with the exception of the Chapter on 'Silage,' comparatively few references are made to experiments conducted in this country. This is, doubtless, due in part to the fact that our experiment stations are comparatively new institutions, and that thus far but few workers are engaged upon purely scientific problems; much, however, of scientific interest, and that would add to the value of the work, has been overlooked.

While the work is a veritable storehouse of information, there is a profuseness of statement and an elaboration of details which seriously detracts from its usefulness, either as a ready work of reference or as a text-book for the student or progressive farmer. Sharp, clear-cut statements of principle and of fact are attractive, and appeal quite as strongly to the general reader in works of a scientific nature as in other lines of literature.

EDWARD B. VOORHEES.

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The Sense of Beauty, being the Outlines of Æsthetic Theory. GEORGE SANTAYANA. New York, Charles Scribner's Sons. 1896.

So much has been written upon the theory of Æsthetics which, from the point of view of the trained intelligence, is nonsense pure and simple that the appearance of so noteworthy a

book on the subject as that of Dr. Santayana ought to receive special mention in the pages of SCIENCE. For the scientific man must ever have before him as a warning, the sad loss of the æsthetic and literary sensibilities which befell Darwin—a loss which, however much one may be given up to an absorbing pursuit, it is easily possible to prevent if one will but give oneself now and then a full and unrestrained bath, of short duration it may be, in some form of æsthetic enjoyment or of æsthetic speculation. If the college professor can spend his summers in painting pictures, as more than one college professor in this country is known to do, he will be reasonably sure to keep himself a happy human being and at the same time to detract nothing from his sum-total of scientific energy. But without so much of a draft upon time and native powers as this implies, a degeneration of the æsthetic faculty can be warded off in simpler ways—by a few months' absorption now and then in European picture galleries or in Swiss mountain scenery, by attaching to oneself a few artist friends if opportunity permit, by a breath of vigorous English poetry before going to sleep at night, or by many another similar device. While Darwin is the great example of a confessed total atrophy of the æsthetic feeling, it cannot be denied that in England the scientific man is more frequently a man of wider culture and experience, that scientific society is less likely to be unbearably monotonous and dull, than in this country. No doubt there is a larger number of cultivated families in England out of which the scientific contingent may be recruited, but at the same time that peculiar American energy which enables many a poor boy to become a master in his chosen field of intellectual activity would enable him at the same time to do something more, if he were once to be convinced that the charm of living, and hence the only pleasure of living (aside from the low pleasure of a gratified ambition), is indissolubly connected with the development of the æsthetic sensibilities.

The point to be particularly insisted upon in connection with the book before us is that *reading about art* is sometimes no less effective than the work of art itself, not only in turning the attention to such appeals to artistic enjoyment as may fall within one's field of view, but also in producing an actual sharpening of those senses through which the art appeal is made.*

The follower of scientific pursuits will do well, therefore, if he does not fail to make himself acquainted with so keen and luminous an imparting of the nature of the feeling of the artist in the presence of the work of art as this book contains.

In gratitude for so much that is of value, the dispassionate reader will doubtless be able to overlook, or at least not to lay up against the author, the passages of a silly and sickly sentimentality, in which he maintains, that a zealous philanthropy and a pure love of science are but the fires of stifled sexual passion bursting out in a different form. A thesis so wide of the mark as this will be as repugnant to the true artist as it is to the clear-brained psychologist, and it will find its audience only with those who have been made blind to the healthy aspects of human life by the novelist of degenerate France.

C. L. F.

BALTIMORE,

* The present reviewer has a definite experience to communicate upon this point. Upon one occasion I had spent the whole afternoon in reading Charles Auchester (a marvellous book, when we consider that its author was only seventeen years old when it was written). I had been completely absorbed in the book, and had had no other thoughts for several hours. I then dressed quickly, and went out to dinner. The people at the dinner table were all wel known to me and I was not expecting anything unusual, but I found to my surprise that I heard them with new ears. I perceived that their voices had a thousand shades of meaning, revealed a thousand qualities of character and mood, that I had hitherto been deaf to. It even seemed to me a kind of immodesty to perceive their bare souls so plainly as I now did through their voices. I had to use, in order to describe this experience, phrases similar to those which are common for vision—my ears were opened; I felt that hitherto I had heard as through a fog dimly; my ears had become unveiled; it seemed as if a lot of obstructing layers had been peeled off from my organ of hearing. If I could only have kept up this high tension of the aural intelligence and the aural sensitiveness I should, no doubt, have become easily a person of better capacity for the enjoyment of music that I am now, as well as a keener critic of my fellow men.

SCIENCE

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FRIDAY, SEPTEMBER 10, 1897.

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THE MEETINGS OF THE AMERICAN AND BRITISH ASSOCIATIONS FOR THE ADVANCEMENT OF SCIENCE.

THE current progress of science and the activity of scientific thought in the civilization of the present day have been signalized in a noteworthy manner by the meetings of the American and British Associations for the Advancement of Science, and of kindred societies, held recently at Detroit and Toronto. As might have been expected, the meeting of the American Association at Detroit and that of the British Association at Toronto both fell somewhat short of the average numbers in attendance; but, on the other hand, both meetings were above the average in the number and quality of the addresses and papers presented and in the enthusiastic interest of the participants. The meetings of the affiliated societies were marked likewise by the high order of the papers read and by the profound interest of the discussions and conferences of the members and foreign guests in attendance. To one present at these meetings and cognizant of the zeal, fidelity and good cheer of the delegates assembled, it would hardly appear that scientific men are seriously disturbed by those publicists who think that science will soon overreach itself, if it has not already fallen into 'bankruptcy.' Nor could one who heard a number of the scholarly addresses delivered at these meetings, addresses remarkable for their literary finish as well as for the value of their contents, entertain the scholastic fear that the perfume of the

Attic violet is likely to be stifled by the mephitic odors of the laboratory.

The sessions of the American Association at Detroit were held during the week beginning August 9th, under the favorable auspices presented by a beautiful city and by the admirable facilities of the Detroit Central High School. The ample accommodations of this building, the generous hospitality of the citizens of Detroit, and the assiduous labors of the local committee, afforded an ideal environment, and one to which the Association will doubtless be pleased to return in due time.

Owing to the death of Professsr E. D. Cope, the duties of the retiring President fell upon Dr. Theodore Gill; while the absence, by reason of illness, of the President-elect, Professor Wolcott Gibbs, threw the labors of the presidency of the Detroit meeting on the next senior Vice-President, Dr. W J McGee. It was commonly and justly remarked that the fidelity and ability with which Dr. Gill and Dr. McGee executed the arduous trusts thus unexpectedly brought upon them contributed in a most marked degree to the success of the meeting.

The opening session of the Association was held in the spacious auditorium of the high school and proceeded with the usual invocation and addresses of welcome from representatives of the city. Perhaps there is still need of this formula in introducing to a community a national scientific organization whose work and aims are but little known. But its use sometimes leads to inconsistencies and absurdities which are very depressing to men of science. The invocations are not infrequently tantamount to an apology for the existence and to a plea for the toleration (within due limits) of science which are at once needless and undignified; while the labored efforts of unscientific men to welcome science as the 'handmaid of religion' are often painful episodes in an otherwise pleasant greeting.

In spite of the small attendance the meeting must be regarded as one of the most successful in the history of the Association. This happy outcome may be ascribed to a number of causes. Among these may be mentioned the carefully prearranged programs of the sectional committees; the continuity of the meetings, which now run from Monday to Friday without interruption by excursions, etc.; the joint meetings of Sections C and E with the American Chemical Society and with the Geological Society of America, respectively; and the accessions of fresh enthusiasm from the younger members of the Association. The presence and participation of a number of foreign guests added greatly also to the interest of the sessions. The presence, likewise, of a number of past Presidents of the Association was an inspiring feature which ought to be more prominent in the future than it has been in recent years.

As usual, the labors of the Council were wearisome, consuming about eighteen hours per day throughout the week, and leaving but little time for science to those charged with official duties. Some constitutional amendments whose object is to shorten and simplify the business affairs of the Association were adopted. Other changes looking

toward the same end must be considered, doubtless, in the near future, especially in connection with the question of the relations of the Association to the vigorously active affiliated societies.

The election of Professor F. W. Putman to the presidency of the Association was the highest tribute that could be paid him for his long and indefatigable labors as Permanent Secretary. The cordial unanimity of this election was fitly supplemented by the hearty acceptance of the graceful invitations of Boston to hold the semi-centennial meeting of the Association in 1898 in that city. All interested in the advancement of science in America should aim to be present at this next meeting. The Association has a great work to perform, and every friend of science should aid that work by his presence and good fellowship at the meetings even should he not contribute to the formal proceedings.

On Monday, Tuesday and Wednesday, August 16th–18th, the American Mathematical Society and the American Society for the Promotion of Engineering Education held their meetings at Toronto. The spacious accommodations of the beautiful buildings of the University of Toronto were placed at the disposal of the societies, and the University authorities, individually and collectively, were most gracefully attentive to the needs and pleasures of the delegates. The rapid growth and the productive activity of these societies—each now counting more than 200 members, and each printing 300 to 500 octavo pages of proceedings—are at once surprising and gratifying. Their history, which cannot be entered into here, is similar to that of the Geological Society of America. Their work is in many respects allied to that of the American Association for the Advancement of Science, and a closer affiliation with the latter through mutual concessions seems to be the logical and desirable outcome of existing conditions. The meetings held at Toronto were characterized by the well digested contents of the papers presented and by the clearness of exposition shown by the authors. Much interest was given to these meetings also by the presence of a number of foreign guests and members of the societies.

On the afternoon of Wednesday, August 18th, the British Association for the Advancement of Science was welcomed to the Dominion of Canada, to the Province of Ontario, and to the City of Toronto, by the Governor-General, the mayor of the city, and other officials. In these ceremonies the intense patriotism of the jubilee year and the devotion of our British cousins to the work of their Association were alike pleasantly and prominently manifest. On the following evening Sir John Evans, President-elect of the meeting, read his address, printed in a recent issue of this JOURNAL, before a large and brilliant audience. The formal addresses of the Sectional Presidents were given during the forenoon of Thursday, after which the sections proceeded to the presentation and discussion of less formal communications. Daily or more frequent sessions were held by the various sections, and the meeting continued until August 25th. The well-planned excursions and social events con-

tributed greatly to the enjoyment and profit of all.

Delegates from the United States were present in large numbers and participated in the proceedings of this meeting of the British Association. Many of them were courteously invited to sit with the sectional committees and to join them in their deliberations. The formation of new and the renewal of old acquaintanceships, and the free interchange of thought thus afforded, made the meeting seem, to quote the language of the admirable address of Sir John Evans, like a 'family gathering in which our relatives, more or less distant in blood, but still intimately connected with us by lauguage, literature and habits of thought, have spontaneously arranged to take part.'

In its management of business details the British Association presents some instructive points of contrast with our own organization. Without entering here upon a discussion of these points, it may be useful to mention three wherein the British Association appears markedly superior to the American. The first of these is the absence, at the summer meetings, of repeated and prolonged sessions of the Council, or governing body. Secondly, no sessions affording opportunity for miscellaneous debate by members in general are held. The entire energy of the members in attendance may thus be turned toward the object of the Association—the advancement of science. Thirdly, there is the advantage which comes from the greater freedom and powers of the sectional committees. These virtually control the proceedings of their respective sections at any meeting, and the work of a section goes on with the vigor and effectiveness which characterize our independent or affiliated societies. In addition to these administrative matters, one cannot help noting the greater enthusiasm of our British kin for science and for scientific men, and the larger proportion of attendance at their meetings of their best men. With them the meeting of the British Association is one of the most important events of the year. With us, widely separated over a continent, there is less opportunity for the cultivation of enthusiasm and greater difficulty in coming together; but who shall say that these are insurmountable obstacles in the way of a worthy scientific zeal and enterprise?

INTERNATIONAL AMENITIES AT DETROIT AND TORONTO.

In accordance with action taken at Buffalo last year, members of the British Association for the Advancement of Science attending the meeting of the American Association at Detroit were made honorary members of the latter body for the 1897 meeting. Perhaps a score of British and Continental scientists availed themselves of this privilege; several of them took part in the work of the Sections, joining freely in discussion and in some cases participating also in the labors of the presiding officers; and it was a general opinion that the presence of these distinguished representatives of science from over seas contributed materially to the success of the Detroit meeting. Especially noteworthy, as an indication of the comity between the two Associations, was the presence of Professor A. B. Macallum, the Local Secretary of the British Association for the Toronto meeting, who came specially to extend in person the courtesies of this body and to make arrange-

ments for transportation, etc., on behalf of Americans desiring to visit Toronto. The Detroit meeting was unexpectedly successful; it is true that the attendance was barely 300 and therefore below the average, but in number and quality of papers, in value of discussions, and in attendance at sectional meetings it ranked, in the judgment of most of the old-time members present (including four past-Presidents), as one of the best meetings in the history of the Association. The pleasure of the meeting was enhanced by exceptional local interest, displayed not only by the local committee but by the citizens generally, and also by the notably excellent press of Detroit; but a large measure of the pleasure, as well as the success, of the meeting must be ascribed to the presence of so many prominent members of the British Association.

In the opinion of old-time members, the Toronto meeting of the British Association was well above the average in number and quality of communications and in the discussions, while the attendance (about 1360), though less than the average, was fully up to expectations. To this meeting American scientists, and particularly members of the American Association, contributed freely. This participation was encouraged by the older Association in making the general and sectional officers of the American Association honorary members, and in placing members of the American body on exactly the same footing as their own members, *i. e.*, admitting them to the privileges of the Association on payment of the customary membership fee. Some 250 American scientists, including about a score of officers of the American Association, availed themselves of these privileges; of these something less than 100 went directly from Detroit, leaving fully 150 Americans, nearly all members of the American Association, who chose Toronto rather than Detroit as a place for scientific association and discussion, thereby paying the highest possible compliment to the older organization. They were made welcome in the Sections and general meetings; many of them were placed on sectional committees (which are more important in the British body than in the American), and several of them were elected to vice-presidencies; they presented numerous formal communications, joined freely in discussion, aided in administration even to the extent of actually presiding in the absence of the sectional presidents, and contributed in due measure toward shaping the scientific character of the meeting. A noteworthy feature was the attention given in the Section of Geography to a series of papers prepared expressly for this meeting by representatives of our National Geographic Society. In the general meetings and public functions special attention was shown to the American Association collectively as well as to the individual members; the officers were invited to occupy platform seats, and at the closing banquet two representatives of the American body were among the rather limited number of speakers. At this banquet, as on other occasions, the members of the two Associations had the same footing; some officers of both were guests, the list including the general officers, Vice-Presidents, and past-Presidents of the American Association. In thus extending courtesies to the younger organization of similar aims, the British Association departed considerably from its traditions and its eminently conservative custom; and it cannot be doubted that the departure must be credited in the first place to the good offices of the local committee, and in the second place to the exceptionally large common membership, growing out of the fact that in Canada the fields of the two Associations overlap.

The near conjunction of the two meetings in time and place has undoubtedly been most beneficial; it has extended individual

acquaintance between investigators pursuing related lines of research; it has made each Association better acquainted with the character and purposes of the other; it has increased mutual esteem between the men and institutions; and it strengthened both bodies in attendance and in quality and quantity of work, and has been especially beneficial in diffusing knowledge of and interest in scientific matters among the people of two countries. Some of the benefits were felt at the meetings; yet it seems fair to regard these as but the germs of greater benefits to come as the personal and collective relations begun at Detroit and Toronto mature and strengthen.

It seems specially desirable to note the international amenities characterizing the Detroit and Toronto meetings, since minor misapprehensions have come to the surface. For example, it has been alleged in the newspapers that certain members of the American Association were treated with discourtesy at the Toronto meeting. It must be evident, in view of the prevailing harmony and the unprecedented warmth of the courtesies extended by each of the Associations, that the sources of individual criticism are to be found in personal matters and not at all in general feeling. It may not be amiss to add that the Local Secretary of the British Association has explained, through the public press, that certain Americans, who complained, through the medium of associated press despatches, of discourtesy at Toronto, were not registered as members of the British Association, and therefore occupied the precise footing of the general public, which, in the British Association, is not entitled to admission to the meetings or other participation in the work of the body. The great and significant fact is that the relations between the two Associations at Detroit and Toronto were most cordial, sympathetic and beneficial; this fact assuredly overshadows any and all petty misapprehensions, and must serve to render the meetings memorable.

W J McGee.

THE SPREAD OF LAND SPECIES BY THE AGENCY OF MAN; WITH ESPECIAL REFERENCE TO INSECTS.

Among the many influences which during the last century or two have been affecting that unstable condition of life which is expressed in the words 'the geographical distribution of animals and plants' none has approached in potency the agency of man exerted both purposely and unwittingly or accidentally.

Natural spread was for centuries the rule. Species dispersed under natural conditions along the line of least resistance. Winged animals and seeds were spread by flight and by the agency of winds, and at their stopping places thrived or did not thrive according as conditions were suitable or not suitable. Aquatic animals and plants and small land animals and plants were distributed by the action of rivers and streams and by the ocean itself. Wonderful migrations have occurred, commonly with birds, more rarely with other animials; ice floes and driftwood have carried animals and plants far from their original habitats and even volcanic action has taken part in the dispersal of species. Smaller animals, especially mollusks and insects, and the seeds of plants have been carried many hundreds of miles by birds and lesser distances by mammals.

With the improvement of commercial intercourse between nations by land and by sea another factor became more and more prominent, until in the present period of the world's history the agency of man in the spread of species, taking all plant and animal life into consideration, has become the predominating one. Potentially cosmopolitan forms, possibly even insular in-

digenes, have by this important agency become dispersed over nearly all of the civilized parts of the globe, while thousands of other species have been carried thousands of miles from their native homes, and have established themselves and flourished, often with a new vigor, in a new soil and with a novel environment.

It is obvious that this agency is readily separable into two divisions : *a*, intentional; *b*, accidental.

a. Intentional Importations. Since early times strange plants and animals have been carried home by travelers. Conquering armies have brought back with the spoils of conquest new and interesting creatures and useful and strange plants. With the discovery of America and with the era of circumnavigation of the globe such introductions into Europe of curious and useful species, plants in particular, increased many fold, while with the colonization of America and other new regions by Europeans there were many intentional return introductions of Old World species conducive to the welfare or pleasure of the colonists. Activity in this direction has been increasing and increasing. Public botanical gardens and many wealthy individuals in all quarters of the globe have hardly left a stone unturned in their efforts to introduce and acclimatize new plants, particularly those of economic importance and æsthetic quality, not failing occasionally, it must parenthetically be said, to establish some noxious weed, or some especially injurious insect; while it is safe to say that probably the majority of the desirable plants of Europe which will grow in the United States have already been introduced, and that there has been an almost corresponding degree of activity in the introduction of desirable plants from the United States into Europe. In all this host of valuable introductions there have been comparatively few which have turned out badly, aside from failures of establishment. The wild garlic (*Allium vineale*), that ubiquitous plant which gives its taste to milk, butter, and even to beef during the spring and summer months in many of our States, is said to have been intentionally introduced by the early residents of Germantown, Pennsylvania. The water hyacinth (*Piaropus crassipes*), originally grown for ornament in a pond near Palatka, Florida, escaped into the Saint John's river about 1890, and has multiplied to such an extent as to seriously retard navigation and to necessitate government investigation. The distribution of the orange hawk-weed (*Hieracium aurantiacum*), a dangerous species which has ruined hundreds of acres of pasture land in New York of recent years, was originally aided by a florist as a hardy ornamental plant. The European woad-waxen (*Genista tinctorium*) was early introduced at Salem, Mass., in fact about thirty years after the settlement of the colony. It has apparently not been used as a dye plant, but for garden and ornamental purposes only. During the last few years it has become a noxious weed throughout Essex and the adjoining counties. Standing on a rock at Swampscott on July 9th, last, the writer was able to see that the country for miles around was colored a bright yellow with enormous masses of this plant. Similar instances are fortunately rare and the majority of our noxious weeds have been accidental introductions.

Intentional introductions of animals, however, have by no means resulted as advantageously as intentional introductions of plants, with the exception of the truly domesticated species, such as the horse, ass, cow, sheep, pig, dog, cat, poultry, honey bee and silk worm of commerce. Even with such species, the grazing ranges of Australia have been overrun by wild horses to such an extent that paid hunters shoot them at a small sum per head, and the European rabbit has become a much worse plague on the same island continent.

Intentional introductions of wild species, however, have almost without exception resulted disastrously.

At various intervals between 1850 and 1867 a few pairs of English sparrows were introduced into our northeastern States to destroy canker worms, and to-day this species is an ubiquitous and unmitigated pest throughout all the austral and transition regions of North America, finding its limit only at the borders of the boreal zone, while the place of the injurious insect it was imported to destroy has been taken by another and worse insect pest which it will not touch.

In 1872 Mr. W. Bancroft Espeut imported four pairs of the Indian mongoos from Calcutta into Jamaica for the purpose of destroying the 'cane-piece rat.' Ten years later it was estimated that the saving to the colony through the work of this animal amounted to £100,000 annually. Then came a sudden change in the aspect of affairs. It was found that the mongoos destroyed all ground-nesting birds, and that the poultry as well as the insectivorous reptiles and batrachians of the island were being exterminated by it. Injurious insects increased in consequence a thousand fold; the temporary benefits of the introduction were speedily wiped away, and the mongoos became a pest. Domestic animals, including young pigs, kids, lambs, newly-dropped calves, puppies and kittens were destroyed by it, while it also ate ripe bananas, pine apples, young corn, avocado pears, sweet potatoes, cocoas, yams, peas, sugar cane, meat and salt provisions and fish. Now, we are told, nature has made another effort to restore the balance. With the increase of insects due to the destruction by the mongooses of their destroyers has come an increase of ticks which are destroying the mongoos and all Jamaicans rejoice.

The flying foxes of Australia (*Pteropus* sp.) are animals which are very destructive to fruit in their native home. Frequently some well-meaning but misguided person will arrive on a steamer at San Francisco with one or more of those creatures as pets. While it is not probable that any of the flying foxes will thrive in northern California or in fact in Austral regions, the experience is too dangerous a one to try, and the quarantine officer of the California State Board of Horticulture has always destroyed such assisted immigrants without mercy.

Less than thirty years ago (in 1868 or 1869) Professor Trouvelot imported the eggs of the gypsy moth (*Porthetria dispar*) into Massachusetts. The insect escaped from confinement, increased in numbers, slowly at first, more rapidly afterwards, until in 1889 it attracted more than local attention, with the result that in 1890 the State began remedial work. This work has steadily progressed since that time and the State has already expended something over a half million of dollars in the effort to exterminate the insect, and it is estimated that one million five hundred and seventy-five thousand dollars more must be used before extermination can be effected.

Contrast with this a single intentional importation which has had beneficial results. The Australian ladybird (*Vedalia cardinalis*) was introduced into California in 1889 with the result of saving the whole citrus growing industry of the State from approaching extinction through the ravages of the cottony-cushion scale (*Icerya purchasi*). Later importations of the same insect into South Africa and Egypt also resulted beneficially.

We have thus had sufficient experience with intentional importations to enable us to conclude that while they may often be beneficial in a high degree they form a very dangerous class of experiments and should never be undertaken without the fullest understanding of the life history and

habits of the species. Even then there may be danger, as with a new environment habits frequently change in a marked degree.

b. Accidental introductions. The agency of man, however, has been more potent in extending the range of species and in changing the character of the faunas and floras of the regions which he inhabits by means of accidental importations.

The era of accidental importations began with the beginning of commerce and has grown with the growth of commerce. The vast extensions of international trade of recent years, every improvement in rapidity of travel and in safety of carriage of goods of all kinds, have increased the opportunities of accidental introductions, until at the present time there is hardly a civilized country which has not, firmly established and flourishing within its territory, hundreds of species of animals and plants of foreign origin, the time and means of introduction of many of which cannot be exactly traced, while of others even the original home cannot be ascertained, so widespread has their distribution become.

These accidental importations would at first glance seem to have been more abundant with plants than with animals, since the opportunities for the carriage of seed, especially flying or burr-like seed, and especially when we consider the vitality of this form of the plant organism, are plainly manifold, but I shall later show that possibly even this obvious generalization must be modified in view of the multitudinous chances for free travel which the smaller insects have under our modern systems of transportation.

The agencies which have mainly been instrumental in the accidental distribution of plants are:

1. Wind storms. It is obvious that light flying seeds may be carried many hundreds of miles by hurricanes and may fall in new regions.

2. Water. This is a very important agency in the distribution of plants upon the same continent, but less important as affecting intracontinental distribution. Still they may be carried by this means from one island to another adjoining island, and when lodged in the crevices of the driftwood they undoubtedly travel greater distances.

3. Birds. Seeds are frequently carried great distances by birds. Many of the larger seeds will germinate after passing through the alimentary canal of a bird, and may thus be eaten at one point and voided with the excrement at a widely distant point. It has been shown, for example, that the local distribution of *Rhus toxicodendron* is greatly affected by the carriage and distribution of the seed in this way by the common crow. Smaller seeds are carried in earth on the feet of birds. Darwin's example of a wounded red-legged partridge which had adhering to its leg a ball of earth weighing $6\frac{1}{2}$ ounces, from which he raised 32 plants of about five distinct species, is an evidence of the possibilities of this agency, while his experiment with $6\frac{3}{4}$ ounces of mud from the edge of a pond which produced 537 distinct plants, an average of a seed for every 6 grains of mud, is still more conclusive.

4. Ballast. This is the first of the distribution methods which may be combined under the head of 'agency of man.' The discharge of earth ballast by vessels coming from abroad has been a notable means of distribution of plants by seed. We have just seen how many seeds may germinate from a very small lump of earth, and the possibilities in this direction of the many thousands of pounds of discharged ballast are very great. In fact the ballast grounds in the neighborhood of great cities are invariably favorite botanical collecting spots; they have usually a distinctive flora of their own, and from these centers many introduced plants spread into the surrounding country.

5. Impure seed. The great industry in the sale of seed which has grown up of late years is responsible for the spread of many plant species, principally, it must be said, undesirable species. Mr. L. H. Dewey says: "It may be safely asserted that more of our foreign weeds have come to us through impure field and garden seeds than by all other means combined."

6. The packing material of merchandise. The hay or straw used in packing crockery, glassware or other fragile merchandise is a frequent carrier of foreign seeds. Such goods frequently reach the retailer without repacking, and the hay or straw is thrown out upon the fields or used as bedding for domestic animals and carried out with the manure.

7. Nursery stock. Plants are often accidentally introduced by means of seeds, bulbs and root stocks attached to nursery stock or among the pellets of earth about the roots of nursery stock. The extraordinary development, of late years, of commerce in nursery stock has undoubtedly been responsible for the intracontinental carriage of many species of plants in this way.

Instances of the accidental spread of larger animals by man's agency are necessarily wanting. Of the smaller mammals the house rat and the house mouse have been accidentally carried in vessels to all parts of the world and have escaped and established themselves, the former practically everywhere except in boreal regions, or only in its southern borders, and the latter even as far north as the Pribyloff Islands, as I am informed by Dr. Merriam. Small reptiles and batrachians are often accidentally carried by commerce from one country to another, but although there are probably instances of establishment of such species none are known to me at the time of writing.

Land shells are often transported accidentally across the ocean in any one of the many ways in which the accidental transportation of plants and insects may be brought about, and by virtue of their remarkable power of lying dormant for many months are able to survive the longest journeys. The conditions which govern the establishment of species in this group, however, seem somewhat restrictive, whence it follows that comparatively few forms have become widespread through man's agency, although Binney mentions a number of European species which have been brought by commerce into the United States and have established themselves here, mainly in the vicinity of the seaport towns of the Atlantic coast.

With the earthworms a striking situation exists. It has been shown that, "without a single exception, the Lumbricidæ from extra-European regions are identical with those of Europe; there is not a variety known which is characteristic of a foreign country."* Careful consideration of the evidence seems to show that this is due to accidental transportation by the agency of man.

Comparatively little has been done in the study of the geographical distribution of insects. In the words of Wallace:

"The families and genera of insects are so immensely numerous, probably exceeding fiftyfold those of all other land animals, that for this cause alone it would be impossible to enter fully into their distribution. It is also quite unnecessary, because many of the groups are so liable to be transported by accidental causes that they afford no useful information for our subject, while others are so obscure and uninteresting that they have been very partially collected and studied, and are for this reason equally ineligible."

Nevertheless, the time has already arrived with some groups, and is not far distant

*F. E. Beddard, Text Book of Zoogeography, Cambridge, 1895, p. 153.

even with the others which Mr. Wallace has termed 'obscure and uninteresting,' when, owing to the indefatigable industry of entomologists as a class, important facts can be gained along distribution lines from the group of insects. Thus it is only within the past few months that the publication of Mr. W. F. Kirby's 'Catalogue of the Odonata of the World' has made it possible for Mr. G. H. Carpenter, of the Royal Dublin Society, to prepare a comprehensive paper on the geographical distribution of the dragon-flies, a group in which a comparatively few workers have interested themselves. It is in a measure true to-day, as it was entirely true when Wallace wrote, that "many of the groups are so liable to be transported by accidental causes that they afford no useful information for our subject," yet even with the group in which the greatest obscurity as to the original home of the species has existed, owing to a very easy and most frequent commercial transportation—the Coccidæ or scale-insects—the continued discovery and characterization of new forms from all parts of the world, and especially of those existing in wild regions, away from the influence of man, are gradually giving us an insight into the probable character of the original coccid faunas of more or less restricted regions.

By reason of the drawbacks mentioned, Wallace considered only "a few of the largest and most conspicuous families which have been so assiduously collected in every part of the globe and so carefully studied at home as to afford valuable materials for comparison with the vertebrate groups." These groups included 16 families of diurnal Lepidoptera and six of the families of Coleoptera. Even with this restriction among the beetles, however, he must have had some difficulties with the accidental importations, for among the beetles are hundreds of examples of this class of introductions. For example, writing later in his Island Life, the great naturalist shows that in 1880 the total number of species of beetles known in the Azores amounted to 212, of which 175 were European. Out of these, however, no less than 101 were believed to have been introduced by human agency. Concerning St. Helena he quotes Mr. Wollaston's opinion that 74 of the 203 species have certainly been introduced by the agency of man.

In considering the question as to the regions with which an interchange of forms is most likely to occur, it is obvious that they are those which have the greatest similarity of climate, and, most nearly, identity in point of time of seasons, those in fact which are most likely to afford similar environmental conditions. A study of the similarity of faunas and floras already existing will lead us to the same result. Wallace has pointed out that with the Coleoptera the best marked affinities between regions are those between the Nearctic and the Palearctic, the Oriental and Australian, the Australian and the Neotropical, all of which appear to be about equal in each case. Next comes that between the Ethiopian and the Australian on the one hand and the Ethiopian and the Neotropical on the other, which also appear about equal. Then follows that between the Nearctic and Neotropical regions, and lastly, and by far the least marked, that between the north temperate and south temperate regions.

Further, in the consideration of accidental commercial importations, the amount and frequency of commercial interchange and the rapidity of the journey are most important factors.

From all of these considerations combined we arrive at the conclusion that the regions with which accidental interchange of species should be most frequent are Europe and North America, and this is with insects to a certain extent borne out

by the facts. The introduction of species from Europe into North America is of every-day occurrence and their establishment is far from rare. The carriage of American species to Europe is an equally frequent matter, but their establishment is much less frequent.

I have studied in this connection—my profession being that of an economic entomologist—principally the species which are prominent as injurious to horticulture or agriculture or in other ways inimical to man. Listing the insects of prime economic importance in the United States, the species each of which almost annually causes a loss of hundreds of thousands of dollars, we find that they number seventy-three. Of these thirty are native, while thirty-seven species have been introduced, six species being of doubtful origin. Of the thirty-seven introduced species, thirty have come to us from Europe, all, with one exception, as accidental importations.

Of the prominent European injurious insects, on the other hand, but three are said to have come from America; the grape-vine Phylloxera (*Phylloxera vastatrix*), the woolly root-louse of the apple or 'American blight' (*Schizoneura lanigera*), and the Mediterranean flour moth (*Ephestia kuhniella*). Of these but one is certainly American—the Phylloxera. The origin of the Schizoneura is somewhat doubtful, while the Mediterranean flour moth is not American, but probably came to us from Europe, although originally it is probably Oriental.

As with these insects of prime economic importance, so it is with other less noted species. There have been rather frequent establishments of European species in America, but practically none of American species in Europe. The reason for this curious condition of affairs is difficult to find. The general trend of accidental importations seems to have been westward, and it is doubtless a fact that certain of our now cosmopolitan forms were originally Asiatic and have traveled westward, through Europe, to and across America, and thence to Hawaii, New Zealand and Australia. The existence of such a law is borne out in the study of plants as well. The statement just made regarding insects of prime economic importance is almost exactly paralleled with the plants classed as weeds. It has thus been shown that, out of two hundred American weeds, one hundred and three are introduced, of which ninety-six are from Palearctic regions, sixty-eight being native to Europe, while it seems that less than half a dozen American species have become troublesome in Europe. A number of American species, however, have been carried to Australia and flourish there with vigor.

This general trend from east to west has always been in the direction of the newer civilization—from the older civilization to the newer. That this in itself is significant cannot be doubted, and in the case of the insect and plant enemies of agriculture the facts surrounding this condition are almost in themselves sufficient to account for this directive movement. I have shown in another paper that the denser population of the older countries and the resulting vastly smaller holdings in farms, the necessarily greatly diversified crops, the frequent rotations of crops, together with the clean and close cultivation necessitated by the small size of the holdings, and the cheaper and more abundant labor, will all operate as a barrier against the establishment of injurious species, while the reversed conditions in a newer country at once liberate an introduced species from the repressive conditions which affected it in its original home and encouraged its establishment, multiplication and spread. But there are deeper causes than this at work. It has been suggested that the flora and fauna of America, the older continent, have

become degenerate through age and cannot successfully resist competition with the more vigorous forms introduced from the younger continent of Europe,* and that there are not-yet-formulated climatic differences favorable to the development of Palearctic forms on the American continent; but these theories seem insusceptible of proof, and for the present we must content ourselves to accept the facts as we find them.

The insects which are accidentally imported are carried in three main ways. Either (1) they are unnoticed or ignored passengers on or in their natural food, which is itself a subject of importation, such as nursery stock, plants, fresh or dried fruit, dried food stuffs, cloths, lumber or domestic animals; or (2) their food being the packing substances used to surround merchandise or the wood from which cases are made, they are thus brought over; or (3) they may be still more accidental passengers, having entered a vessel being loaded during the summer season, and hidden themselves away in some crevice. The coleopterists (Hamilton and Fauvel) make a distinction by name among these classes, calling the first group 'insects of commerce' and the latter 'accidental importations.'

It would appear on the face that these more strictly accidental importations must be rarer than those which are termed commercial importations, yet of the 156 introduced Coleoptera recorded by Dr. Hamilton in 1889, sixty only were considered by that writer as insects of commerce, while 96 he thought had been brought over in this accidental way.

The remaining Coleoptera common to North America and the Palearctic region, 278 in all, Dr. Hamilton considers to be practically circumpolar species, or at least not imported. Fauvel in his remarks and additions to Hamilton's catalogue raises the number of non-introduced or circumpolar species to 366, leaving 125 as imported, of which only 28 appear to have been imported from temperate Europe, the rest being cosmopolites or subcosmopolites. Of the latter class he thinks that 59 originally came from the temperate Europeo-Siberian fauna, 10 from the Oriental fauna, 15 from the Ethiopian, 4 from the Neotropical, 7 being uncertain and 2 unknown.*

It should be noted, however, that there is grave room for difference of opinion regarding a number of the European species considered by him as indigenous to North America. *Scolytus rugulosus*, *Hylastinus trifolii*, *Anthrenus scrophulariæ*, *Sitones hispidulus*, *Cryptorhynchus lapathi*, and a number of others which might be specified, have undoubtedly been imported from Europe and were quite possibly originally imported.

There are obstacles in the way of the establishment and spread of species which are imported quite by accident which usually do not exist in the case of the so-called commercial importations. In many cases, entering the vessel by accident, they exist there as single individuals, and upon liberation, even should the conditions be favorable, only gravid females could perpetuate the species. Then also the majority of such specimens are liberated, upon the unloading of the vessel, upon the wharves. The water front of a seaport city is not a favorable place for the establishment of a species which feeds on living vegetation. Frequently, even when it is a species well fitted for acclimatization, it will have to fly or be carried for miles inland before it can find a place possible for the establishment of the species. So it happens that while foreign insects are frequently found in living condition about the wharves of our

* The spread of European species in Australia has been explained by the superior energy of the younger races of the Palearctic region.

* Hamilton, in his 1894 paper, raises the number of Coleoptera common to the two countries to 594, making the number of introduced species 216.

larger seaports during the summer months, almost none have succeeded in getting a foothold in the vicinity. Mr. Otto Lugger, when living in Baltimore, Md., made a collection of many species of foreign insects found upon the wharves, yet he has recorded the establishment of but a single species, viz, *Aphodius erraticus*, an European dung-beetle, which managed to get to Druid Hill Park, where it bred in the dung of the tame deer, afterwards spreading into the surrounding country and breeding in the dung of sheep and other domestic animals.

Practically, therefore, after many years of the most active commerce, the insect faunas of the immediate vicinity of the larger seaports, like New York, Boston, Philadelphia and Baltimore, have not been greatly changed by the introduction of foreign elements.

All of the household insects and true city insects are, of course, exceptions, to this conclusion and the strong flying, vigorous, and simple living dipterous insects—the very ones most likely to enter a loading vessel and to escape on the discharge of its cargo—will many of them find proper places for breeding. It is likely that a much larger proportion of the many species of Diptera common to Europe and North America have been brought over in this accidental manner than is the case with the Coleoptera.

But often these purely accidental species are carried inland in packing cases, into the cracks of which they may have crawled, or even in the trunks of passengers, and they may then be liberated in more favorable localities. For example, Mrs. H. G. Hubbard, after spending the summer on Prince Edward's Island, returned in the autumn to Detroit, Mich., and in unpacking her trunks her husband found two specimens of *Phytonomus punctatus*, a species not previously known to occur in Michigan, although found there in injurious numbers a year or so later. It is altogether likely that the imported elm leaf-beetle (*Galerucella luteola*), an insect which enters houses for hibernating purposes, was first brought to America in this manner.

It is, however, the accidental commercial importations which theoretically stand the best chance of establishing themselves, since, in the first place, they are generally imported in or upon their natural food. In the second place, they generally occur in considerable numbers, instead of as isolated individuals, as with the more purely accidental importations; and, in the third place, they are usually carried as originally packed, far from the port of entry.

With insects brought over on plants or nursery stock the conditions could not well be much more favorable. Their supply of food is looked after with care, the host plant is soon put in the ground in the best of surroundings, and the greatest care is taken of the choice importation. Upon or in importations of this kind are carried Coccidæ in all stages of growth, and often, fortunately, their enclosed parasites, the eggs of Aphididæ, the larvæ of wood-boring Coleoptera, the eggs of many other insects, the cocoons of small Lepidoptera, and probably even in rare cases the larvæ of Lepidoptera, since it now seems likely that *Euproctis chrysorrhœa* was imported into Massachusetts on nursery stock in its larval hibernacula. The Coccidæ, however, are most abundantly carried in this way. Under natural conditions these insects have usually a rather restricted distribution, but by means of this commercial distribution many of them have become of almost world-wide range, and the end will certainly not be reached until every country possesses every species of scale insect which can possibly live in its climate. A few instances drawn from a recent paper by Mr. Cockerell will illustrate this fact:

Diaspis amygdali, or *lanatus*, was described from Australia in 1889. To-day we know it

from Australia, Ceylon, Hong Kong, Japan, several localities in the United States, Jamaica, San Domingo, Grand Cayman, Barbadoes, Martinique, Trinidad and Cape Colony.

Aulacaspis rosæ was described from Europe, but is now found also in the United States, Australia, New Zealand, the Sandwich Islands, China and Jamaica.

Chionaspis citri was described from Louisiana and Cuba in 1883 and is now known from Trinidad, Antigua, Demarara, Bermuda, Mexico, Tonga, New Zealand and Australia.

Howardia biclavis was described in 1883 from specimens on hothouse plants in Washington, D. C. Now it is known out-of-doors from Trinidad, Mexico, Tahiti, Sandwich Islands and Ceylon.

Lecanium oleæ is found in Europe, the United States, the West Indies, Mexico, Sandwich Islands, New Zealand, Australia and Cape Colony.

The hymenopterous parasites of the Coccidæ, by virtue of their mode of life, have spread almost equally with their hosts by means of this commercial transportation. I have been able to show recently that by this means a number of species of the Chalcidid subfamilies Aphelininæ and Encyrtinæ have, in comparatively recent years, become cosmopolites. For example:

Aspidiotiphagus citrinus, originally described from California in 1891, is now found in many other portions of the United States, in the West Indies, Italy, Austria Ceylon, China, Formosa, Japan, Cape Colony, Queensland, South Australia and Hawaii. Practically the same remarkable distribution is followed by *Prospalta aurantii*, *Aphelinus mytilaspidis*, *A. diaspidis* and *A. fuscipennis*, while the remarkable and system-breaking Encyrtine—*Arrhenophagus chionaspidis*, described by Aurivillius from Swedish specimens in 1888, has since been found in Austria, Italy, several portions of the United States, Ceylon, Japan, Formosa and China.

Only second to the Coccidæ in the facility with which they are transported in this way are the Aphididæ. These insects, however, are fragile, soft-bodied and unprotected. They are readily carried, however, in the winter-egg condition and many species are rapidly becoming cosmopolitan. They have not been studied, however, elsewhere than in Europe and the United States, and the extent to which this commercial distribution has been carried can only be surmised. A suggestion of this extent, however, occurred to me when within the past few weeks specimens of *Aphelinus mali*, a common parasite of Aphididæ in Europe and North America, were received from such a comparatively out-of-the-way corner of the world as Passarœan, Java.

Other still smaller and still less studied insects are undoubtedly carried by this method of transportation, as the recently discovered identity of certain North American Thysanopterâ with those of Sweden and Russia would seem to show. The small plant-feeding mites of the family Phytoptidæ are particularly subject to this form of commercial distribution, and when they are fully studied, it will doubtless be found that many forms have become subcosmopolitan.

Of larger insects, nearly all of the wood-boring beetles common to Europe and the United States have probably been brought over in this way. *Zeuzera pyrina*, the large wood-boring cossid moth, also probably came over on living plants; and, as I have just stated, the newly imported brown-tail moth, *Euproctis chrysorrhœa*, was probably at Boston with nursery stock.

Careful observations on the insects transported with this class of merchandise have never been made, except, possibly, at the port of San Francisco. At this port the

State Board of Horticulture has established, under State laws, a quarantine for all incoming plants and fruit. The entomologist and quarantine officer, Mr. Alexander Craw, has entire jurisdiction over such articles consigned to points within the State, and examines, destroys and fumigates at his discretion. He has not, however, in his reports, given us complete lists of the insects collected in this work, although I understand, from persons who have visited his office, that he has preserved collections of the more important species from an economic standpoint. The vessels examined have, almost without exception, come from Pacific ports, and the difficulty of naming insect material thus received would be very great. It is this fact which has probably hitherto prevented the publication of a general list. A list of the scale insects, however, has been published.*

Between July 2, 1894, and August 29, 1896, Mr. Crew inspected 232 vessels carrying plants or other articles liable to be infested with living insects, and consigned to California individuals or firms. 122 lots he found clean and passed; 40 lots he admitted after fumigation; 20 lots he destroyed and 78 lots he destroyed in part. One lot, consisting of 1,000 boxes of apples, he sent back on the refusal of the owner to allow them to be fumigated.

Living plants and nursery stock afford, then, perhaps, the most certain means for the accidental transmission and subsequent establishment of many kinds of insects. Commerce in objects of this class is rapidly increasing and has already assumed considerable proportions, the imports into the United States alone in the fiscal year ending June 30, 1896, having reached a value of nearly $1,000,000, while the previous year they amounted to something over $600,000.

* Bull. 4. Tech. Ser. Div. Entom. U. S. Dept. Agric., 1896, pp. 40–41.

No great elaboration will be needed concerning the importation of foreign insects upon fruits, fresh and dry; other dry food stuffs; cloths; lumber, or domestic animals. Fruits were imported into the United States in the fiscal year 1895–6 to the value of nearly $20,000,000, and, unquestionably, upon imported fruits are carried many insects. The opportunities for the establishment of species coming with fresh fruit, however, are obviously slight as compared with those which come on living plants or in dried food-stuffs, and, as a matter of fact, it appears that already nearly all of the dried-food insects have become cosmopolitan. The same may be said of the insects which affect domestic animals. The forms which are truly parasitic in the larval stage have most of them been carried everywhere, while the other forms which attack domestic animals only as adults have some of them been carried far and wide. As an example, we may recall the European *Hœmatobia serrata*, which was brought to New Jersey probably in 1886, and which has spread over the entire country from Maine to California.

The fact that insects may be, and doubtless are, transmitted in the material used in packing heavy or delicate merchandise must not be overlooked. We have already shown that dangerous weeds have been transmitted in this way, and when the material is hay or straw the danger of importing certain injurious insects becomes great. *Cecidomyia destructor*, the well-known Hessian fly, is supposed to have first been brought to the United States from Europe in straw bedding on troop vessels during the War of the Revolution, and to have recently been carried from Europe to New Zealand in the straw packing of merchandise. Laws recently proposed in New Zealand, Australia and Cape Colony provide that such straw or hay packing shall be burned immediately the case is opened.

Dr. H. Loew, in his well known paper, 'Ueber die Diptern-fauna des Bernsteins,' has shown that several of the species of the genera *Oscinis* and *Chlorops* have gained a wide distribution through commerce, and this probably happened through their occurrence in hay or straw used as packing, since they live in the stems of grains and grasses. Dr. Loew, by the way, considered the Diptera, by virtue of the simple conditions required for their existence, to be peculiarly susceptible to commercial and accidental distribution, and was inclined to believe that the majority of the many species common to Europe and North America have been imported into the latter country. He understood, however, the existence of a circumpolar fauna and wrote wisely and learnedly about the common ancestry of what he called analogous species. Whatever may be the cause, the Diptera seem fitted in the individual to withstand widely differing environmental conditions. The group, as a whole, has apparently little faunistic value either along broad lines or in a more restricted way. There are comparatively fewer characteristic genera in the main faunal regions of the world than in other groups of animals, and in our own country there are comparatively few species of restricted distribution. Very many individual species range through the Lower and Upper Austral, through the Transition and into the Boreal regions.

Aside from the Diptera, grains and grasses all over the world are subject to the attacks of a host of insects of all kinds, many of which hibernate on or within the stems, so that the proposed legal provisions of the English colonies mentioned are by no means unwise. The substitution of the wood material known as 'excelsior,' the use of which is becoming so common in this country, or of some other packing material, will shortly do away with a large share of this danger.

There are, of course, other less important methods by which insects may be transported, such as in earth or damp moss about the roots of plants and in sand used for ballast. These methods, however, are not very important as a rule, although it is stated that the destructive chigoe (*Sarcopsylla penetrans*) was carried in ballast in 1872, on a vessel from Rio Janeiro to the coast of Guinea, where it has established itself most perfectly, having been found 200 miles inland by Stanley.*

There remains one more source of accidental introductions and it is one which has been reasonably prolific as regards insects on several occasions. I refer to international expositions, which are now becoming of almost annual occurrence. At the Centennial Exposition at Philadelphia, in 1876, the insects occurring in the exhibits, especially of foreign grains, received some study by Dr. Riley, who published a short note in the Proceedings of the St. Louis Academy of Science for October 2, 1876. A special committee of the Philadelphia Academy, consisting of Drs. Horn, Leidy and Le Conte also prepared and published a report at this time, but none but well known and cosmopolitan forms were found. I am not familiar with the results of any studies of a similar nature made at the Paris Exposition Universelle of 1889, but have seen the title of a paper by M. Decaux which reads 'Etudes sur les insectes nuisibles receuillis à l'Exposition Universelle,' Paris, 1890, which, however, I have not been able to consult.

In 1893, however, careful observations were made at the World's Fair at Chicago by Mr. F. H. Chittenden, the results of which were published by Dr. Riley in Volume VI. of Insect Life. Insects to the number of 101 species were found in grain and other stored vegetable products. Seven species were found affecting animal products

* 'Die Umschau,' July 17, 1897, p. 523.

and 13 wood-feeding species were found in the forestry building. The interesting and significant fact is mentioned in this article that there was an exchange of seed samples between the representatives of different countries, which would, of course, greatly facilitate the spread of seed-inhabiting insects, and it was further shown that thousands of samples were taken away from open bags by visitors from all parts of this country and probably from other parts of the world. Moreover, at the close of the Exposition the sheaves of cereals used in the decorations were taken away by armfuls by visitors. After summarizing the habits and countries of origin of the different species, however, Dr. Riley expressed the opinion that no dangerous importations were made at this time. It seems altogether likely, however, that *Phyllotreta armoraciæ*, a European species which has established itself in northern Illinois, Iowa and Wisconsin since 1893, and which was found by Mr. Chittenden in that year in vacant lots near the exposition grounds, was an exposition importation. Moreover, an interesting Calandrid of the genus *Tranes*, the species of which are all Australian, has established itself injuriously in greenhouses in St. Louis as the result of the introduction of two plants of *Zamia spiralis* which were bought at the World's Fair. With these instances in mind we cannot but admit that other species heretofore overlooked probably escaped and have become acclimatized as the result of this exposition, and that such occasions, occurring as they do more and more frequently and drawing constantly increasing material from all parts of the world, will, unless precautionary measures are instituted, afford more and more frequent opportunities of a very favorable kind for the spread of injurious species.*

We have thus seen how great the opportunities are under our modern conditions for the transportation, in proper condition for establishment, of insects of many groups, and from this point of view it seems strange, in view of the very numerous importations, that more species do not become acclimatized even in North America, where, perhaps, we reach the greatest possibilities in this direction. Our most intimate commercial relations are with the great faunal region most like our own, and these relations are rapidly growing both with Europe on the east and with Asia on the west, although our Asiatic importations are more abundant from the Oriental region than the Palearctic, and from the Oriental we are not so likely to receive species which will acclimatize themselves. We have already pointed out that the faunistic relations with the Coleoptera (and undoubtedly with other groups) are least marked between the north temperature and south temperate regions, and this distinction is never likely to be disturbed by imported species on account of the diametrically opposed seasons. A species starting from Argentina in the height of summer will reach the United States in the dead of winter at a time least likely to favor its acclimatization. This point was first suggested by my colleague, Mr. E. A. Schwarz, in his paper entitled 'The Coleoptera common to North America and other Countries' (Proc. Entom. Soc. Wash. I., 182–194).

It appears from what we have shown that very many species are constantly being imported which do not become acclimatized. Many of the European species which we should most expect to take hold in this country have not done so, while

* During the later months of the World's Fair precautionary measures were instituted under Mr. Chittenden's supervision. Much dry food material was fumigated with bisulphide of carbon, and many samples which were very badly infected were burned. At least four new and dangerous species of insects were destroyed in this way.

with others it is the unexpected which has happened. As Osten Sacken says, speaking of the Diptera: "Importation will not occur for centuries in cases where it might be expected from day to day; and, again, it will sometimes take place under circumstances most improbable, and, *a priori* impossible to foresee." (Proc. Entom. Soc. Lond., 1894, p. 489.)

Why should the well-known *Pieris rapæ* have made its appearance in this country and spread far and wide, while the equally common and injurious *Pieris brassicæ* and *P. napi* have never been found here? Why should *Phytonomus punctatus* have flourished with us when it is hardly known as a clover enemy in Europe, and when the congeneric *Phytonomus meles* of Europe has never been found here? Why should *Coleophora laricella* have established itself here, and none of the other European Coleophoras (some of them of much greater distribution and hibernating in cases of protective coloration and shape, and attached to plants) have acclimated themselves amongst us? Why should *Calliphora vomitoria*, *Crytoneura stabulans* and *Stomoxys calcitrans* have been brought over at an early date and flourished to excess in America and many other countries, while *Sarcophaga carnaria* is unknown in any of them?

Mr. Schwarz has phrased it: "We stand here before some great unknown factor, viz, the individual character and inmost nature of the species which governs the introduction or non-introduction of each species—a factor which is variable according to each species * * *." But there is is no reason why a mystery need be made of this condition. In a word, it is the capacity of the individual species to accommodate itself to a more or less novel environment. Nowhere in the whole animal kingdom do we find the natural environment more complicated than with insects. Conditions are frequently dependent upon conditions in an almost endless chain. The phenomena of fatal parasitism are of vital importance as determining the abundance of the species and are curiously complicated. I have recently proved the existence of several fatal tertiary parasites and the probable existence of quaternary parasites with *Orgyia leucostigma* in Washington. Upon the condition of this chain of interdependencies rests the welfare of the primary host. If adverse conditions affect the quaternary parasite, the primary host suffers, for the tertiary parasites increase and kill off the secondary parasites, allowing an increase of the primary parasites which kill off the Orgyia. The famous instance of Darwin in which he showed that in a measure cats are responsible for the production of clover seed in England through the interrelations of cats, field mice and bumble-bees, is paralleled and outdone again and again among insects. Further, in no group of animals are the characteristics termed special protective resemblance and special aggressive resemblance, to say nothing of protective and aggressive mimicry, so well marked and so important in the life of the species as with the insects. *It is upon the degree of simplicity of its life—the degree of simplicity of its normal environment as a whole—that the capacity of a species for transportation and acclimatization, even into a parallel life zone, depends.*

Nevertheless, I am fully convinced that very many more species will stand transportation from the Palearctic to the Nearctic, from the Australian to the Oriental and the Neotropical regions, than would be supposed from a consideration of these points and from a knowledge of the comparatively few forms which have as yet been transported and acclimatized. Aside from the forms brought in with their food and thus under the most favorable conditions for establishment, it is only by a lucky chance with the average accidental

insect immigrant that it finds conditions for reproduction—a chance which may not occur once in very many times. Osten Sacken has pointed out that *Eristalis tenax* must have been brought here many times during four hundred years before it succeeded in establishing itself. Undoubtedly many of these immigrants die upon our wharves when a lucky chance like crawling upon the clothes of a person and thus being carried out into the country might have resulted in the establishment of the species. Given the *most favorable conditions* and many species will be able not only to accommodate themselves to a new environment, but certain of them will thrive better in the new than in the old. The effort to transport beneficial species from the Australian region and acclimatize them in the Nearctic region seemed a rash and unprofitable experiment on its face, and I confess that I for one had little hope of its success, yet it was successful with several species and transcendently successful with one.

Much has been written of late about the success of the work in the introduction of beneficial insects by Mr. Albert Koebele into Hawaii, under the auspices of the Hawaiian government. Some of the introductions seem, without doubt, to have been strikingly successful. Mr. R. E. C. Perkins has reported at some length upon this success and, in commenting upon its reasons, says:

"It becomes natural to ask why the success of the imported beneficial insects has been so pronounced here, while in other countries it has been attained in a comparatively small measure. The reason, I think, is sufficiently obvious. The same causes which have led to the rapid spread and excessive multiplication of injurious introductions have operated equally on the beneficial ones that prey upon them. The remote position of the islands, and the consequently limited fauna, giving free scope for increase to new arrivals, the general absence of creatures injurious to the introduced beneficial species, and the equability of the climate, allowing of almost continual breeding, may well afford results which could hardly be attained elsewhere on the globe. The keen struggle for existence of continental lands is comparatively non-existent, and, so far as it exists, is rather brought about by the introduced fauna than by the native one."

Mr. Perkins' reasons are all good, but he has not mentioned one prime reason of success, and that is that the most successful of the imported species have come from another portion of the same great faunal region, while others have been received from the region most closely allied, viz, the Oriental.

Wallace took the view that the effectual migration of insects is, perhaps, more than with any other class of animals, limited by organic and physical conditions. "The vegetation," he says, "the soil, the temperature, and the supply of moisture, must all be suited to their habits and economy; while they require an immunity from enemies of various kinds, which immigrants to a new country seldom obtain."

There is much truth in this statement, but it must be remarked that, in practical experience, immunity from enemies of various kinds is what insect immigrants find, not what they leave behind them. It takes some time before they weave a new chain of organism preying upon organism. Our insect importations from abroad when they are of economic importance, and those from Europe are very likely to be of such importance, leave their old insect enemies behind them and frequently are not readily attacked by native ones. These last accommodate themselves to the new comer in time, but for a while he enjoys comparative immunity. The rapid multiplication and spread of *Pieris rapæ*, of *Hæmatobia serrata*

of *Phytonomus punctatus*, of *Porthetria dispar*, of *Anthonomus grandis*, of *Icerya purchasi* and many others may probably be principally laid to this cause.

I should be remiss did I not refer to another aspect of the accidental introduction of species, viz, that it not only adds species to a native fauna, but also that it often causes the disappearance of native forms. Since the establishment, within our boundaries, of *Pieris rapæ*, our native *Pontia oleracea* has almost entirely disappeared in localities in which it formerly abounded, and in some sections has entirely disappeared. Since *Doryphora 10-lineata* came east and multiplied upon the cultivated potato in such prodigions numbers, the formerly common eastern *Doryphora juncta* has become a rare species. Walsh pointed out 30 years ago that one effect of the westward spread of the European *Mytilaspis pomorum* was to cause the gradual local disappearance of the native *Chionaspis furfurus*. Hubbard has shown that the increase of the imported *Mytilaspis citricola* in Florida was followed by the decrease of *Mytilaspis gloverii*, which, though not native, was an earlier importation—a most interesting, and, so far as records go, unique case. Instances might be multiplied which will show that the establishment of foreign species thus often produces at least a dual effect on the character of the fauna as a whole.

In closing, it will not be inappropriate to point out that the accidental importation of species is only one of the ways in which the agency of man is altering the character of native faunas, and that, in spite of its extent, it is really the least of the ways. The influence of civilization is immediately destructive to natural floras and faunas. It is already too late to gain an adequate idea of natural conditions in even recently settled portions of the globe. Wallace has dwelt upon the comparatively scanty and unimportant results to natural history of most of the great scientific voyages of the various civilized governments during the present century, from which it has resulted "that the productions of some of the most frequently visited and most interesting islands on the globe are still very imperfectly known, while their native plants and animals are being yearly exterminated. * * * Such are the Sandwich Islands, Tahiti, the Marquesas, the Phillippine Islands and a host of smaller ones; while Bourbon and Mauritius, St. Helena and several others have only been adequately explored after an important portion of their productions has been destroyed by cultivation or the reckless introduction of goats and pigs." ('Island Life,' p. 7.)

Elsewhere he shows that the introduction of goats into St. Helena utterly destroyed a whole flora of forest trees, and with them all the insects, mollusca, and perhaps birds dependent upon them. And further, that "cattle will, in many districts, wholly prevent the growth of trees; and with the trees the numerous insects dependent on those trees, and the birds which feed upon the insects, must disappear as well as the small mammalia which feed on the fruits, seeds, leaves or roots." Many local American instances have been brought together by Mr. F. M. Webster in an important paper entitled 'Biological effects of civilization on the insect fauna of Ohio,' which comes to me as I write these closing lines.

But the purpose of this address has been to dwell solely upon the question of the spread of species, and I must not touch upon other topics, however closely akin. It seems to me that the practical point to which we must come, after summarizing all that has been shown, is that since so many species have been imported by pure accident, and have succeeded perfectly in becoming acclimatized, may not much be accomplished by wisely planned and carefully guarded

introductions? The somewhat haphazard but none the less important and skillful work of Albert Koebele, first for the United States government, afterwards for the State of California, and now for the Hawaiian government, is certainly an indication, taken in connection with what we have shown, that thorough experimental work with predaceous and parasitic insects promises, in especial cases, results of possibly very great value.

We wish no more destructive birds like the English Sparrow; we have no desire to make an American resident of the Indian Mongoos, nor have we any desire to import the Australian flying fox as a pet. Neither do we desire to allow any more European plants to escape from cultivation and emulate the Russian Thistle. But there are many absolutely beneficial insects of Palearctic regions which might flourish amongst us, and whose intentional introduction could not be harmful from any point of view, while they might be of the greatest service.

L. O. HOWARD.

WASHINGTON, D. C.

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*PHYLOGENY AND TAXONOMY OF THE ANGIOSPERMS.**

IT is unnecessary for me to state at the outset, what is evident to every botanist, that it is as yet impossible to present a complete phylogeny of the angiosperms. Phytopaleontology is too young a science, and the materials with which it deals are as yet far too scanty to have given us direct evidence as to the phylogeny of all families of plants. No one can trace with great certainty from the fossil remains of plants yet discovered the genealogy of any considerable portion of the vegetable kingdom. It will be many a year before the direct evidence we so much desire will leave no considerable gaps to be filled by skillful interpolation. However, after making all due allowance for the imperfection of the record, there are many facts as to past vegetation which are well established. Thus we know that the earliest plants were simple, homogeneous-celled, aquatic organisms. We know that ferns and gymnosperms preceded angiosperms. We know that the angiosperms which first appeared were of lower types, and that the highest types known to-day were wanting until very late in geological time.

It is true, moreover, that we are not confined to the direct evidence furnished by the paleontological record. In the individual development of every plant (its ontogenesis) there is a recapitulation of its ancestral development (phylogenesis). A critical study of the development of the individual must throw light upon the past history of the species. When we know every step in the formation of each plant we shall be able to trace the phylogeny of every species. Here, again, we have to face the fact that our knowledge is still quite fragmentary and that on this account the results are not as definite as we could wish, and yet, when we bring together what we know of the ontogeny of plants here and there in the higher groups, we are able to make out with much certainty not a little as to their phylogeny. To the details regarding these results I will advert somewhat later.

There is still another line of inquiry open to us, namely, the morphological, in which account is taken of the varying development of homologous tissues, members and organs. Rightly interpreted, the results of morphological studies are of very high importance in determining genetic relationships. When differences in homologous parts are regarded as but the expression of variation from a common form they beome indices of relationship, and when

*An abstract of the address of the retiring president, delivered before the Botanical Society of America, Toronto meeting, August 17, 1897.

these indices, obtained from all the tissues, members and organs of a group of plants, are judiciously considered they mark out lines of descent with great distinctness.

We have thus open to us three lines of investigation in the study of the phylogeny of plants, namely: (1) the historical, in which the materials are supplied by phyto-paleontology; (2) the ontogenetic, in which the development of the individual supplies us with the necessary data; and (3) the morphological, in which the different development of homologous parts is our index of relationship. In this paper I propose to bring these three lines of investigation to bear upon the problem of the phylogeny of the angiosperms. * * * *

From all the foregoing we may pretty safely proceed to construct the hypothetical phylogeny of the angiosperms, to serve as the basis of their taxonomy. And let it be fully understood that this is not presented as final, or as entirely satisfactory; it is merely a working hypothesis which claims no other merit than that of an attempt at conformity to the suggestions, sometimes faint, sometimes doubtful, from paleontology, from embryology (ontogeny) and from morphology. That some of these suggestions have been misinterpreted or that others have been overlooked is altogther likely, but in this I beg the indulgence of systematists, who may well realize the difficulties surrounding the problem here undertaken.

HYPOTHETICAL PHYLOGENY OF ANGIOSPERMS.

The angiospermous phylum parted very early into two sub-classes, the Monocotyledons and Dicotyledons. This separation took place while the flower strobilus was still apocarpous, and before any of the strobilar leaves had undergone much if any modification. At this stage the vegetative characters of the sporophyte were so well established that no profound modifications have been undergone since.

The modifications which gave us the main lines of monocotyledons were, first, the fusion of the carpels with one another and the production of a syncarpium, and second, the progressive fusion of the syncarpium with the other strobilar leaves. These resulted in the phylum which begins with Apocarpæ and passes to Coronarieæ, Epigynæ and Microspermæ. In some Apocarpæ and many plants of the type of the Coronarieæ the perianth has been more or less reduced (by aphanisis), in some cases amounting to complete suppression, as in palms, aroids, and sedges and grasses.

The primitive dicotyledons were apocarpous plants which soon developed along two diverging lines, characterized in the one case by the tendency of the leaves of the strobilus to fuse with each other in a transverse direction (transverse symphysis), while in the other the tendency was to a fusion of the leaves in two directions (transverse and longitudinal symphysis). The phylum resulting from the predominance of transverse symphysis began with the apocarpous Ranales, soon developing into the syncarpous Caryophyllales and Malvales. The type of the Caryophyllales became slightly modified in the Primulales by the transverse symphysis of the inner perianth-whorl, resulting in gamopetaly.

In the Polemoniales the type of the Primulales began to undergo modification by aphanisis, resulting in a reduction of the microsporophylls to five, and the carpels in the syncarpium to two or three. Increasing aphanisis produced the Personales and Lamiales with their four or two microsporophylls and irregular perianth, and in the latter group with each carpel restricted to the production of but one or two macrosporangia.

The phylum in which both transverse and longitudinal fusion are well marked proceeds from the apocarpous roseworts to the syncarpous saxifrages of the Rosales,

to the Celastrales in which epigyny is sometimes attained, thence to the Umbellales, where epigyny is constant, and to the Rubiales in which gamopetaly has become a fixed character, culminating in the group of the Asterales with its greatly reduced bicarpellary syncarpium.

Early predominance of aphanisis in some members of the Ranale phylum soon gave rise to the apetalous laurels and nutmegs from the buttercup type. A somewhat later appearance of aphanisis gave rise to the willows, amaranths and buckwheat from the pink type, and the spurgeworts and nettleworts from the mallow type. Similarly, early predominance of aphanisis in the Rosale phylum gave rise to the apetalous plane-trees from the rosewort type, while its later appearance gave rise to the proteads, daphnads, oleasters, sandalworts and loranths from the holly type, and the walnuts, oaks and galeworts from the horsechestnut type.

Early predominance of symphysis gave rise to the peculiar group of the myrtles from the rosewort type, in which by later aphanisis came the hippurids, birthworts and vine-rapes. The Parietales and Polygalales are later developments more or less parallel to the Caryophyllales, while the Geraniales and Guttiferales stand in a similar relation to the Malvales.

TAXONOMY OF ANGIOSPERMS.

As a result of the investigation of phylogeny along the lines of paleontology, embryology and morphology, the following suggestions as to the classification of angiosperms are made :

The angiosperms are separable into two diverging sub-classes, the monocotyledons (Monocotyledoneæ) and the dicotyledons (Dicotyledoneæ), the first ranking structurally lower than the second. The monocotyledons are well divided by Bentham and Hooker into seven series, and these we may accept unchanged with the single exception that the waterworts (Hydrocharitaceæ) should probably be removed from the Microspermæ, to constitute an additional coordinate group. These eight groups, which appear to be deserving of no more than ordinal rank, should then be re-arranged so as to have the following sequence, namely: Apocarpæ, Coronarieæ, Nudifloræ, Calycinæ, Glumaceæ, Hydrales, Epigynæ, Microspermæ. Here it must be understood that the Nudifloræ, Calycinæ and Glumaceæ are separate orders radiating from the present order Coronarieæ, and that the Hydrales constitute a diverging order from the base of the Epigynæ.

The choripetalous and gamopetalous dicotyledons are divided by Bentham and Hooker into six 'series,' one of which, the Discifloræ, should be broken up and its families distributed elsewhere. The remaining 'series,' which appear to have the rank of orders, form two somewhat diverging genetic lines or phyla, each beginning with apocarpous, hypogynous, choripetalous plants, and both attaining syncarpy and gamopetaly, one remaining hypogynous, the other becoming epigynous. An attempt has been made to distribute all the apetalous plants, these having been assigned places in the lower two orders. Since gamopetaly has evidently been attained at more than one point, it is no longer desirable to retain the Gamopetalæ as a distinct group. It must constantly be borne in mind that these orders and their sub-orders, as well as the families, are diversely related to one another, sometimes serially, but more commonly divergently, as the twigs of a tree are related, now by direct extension, and then by lateral branching.

Class ANGIOSPERMÆ.

Sub-class MONOCOTYLEDONEÆ.
 Order Apocarpæ (3 families).
 Order Coronarieæ (8 families).
 Order Nudifloræ (5 families).

Order Calycinæ (3 families).
Order Glumaceæ (5 families).
Order Hydrales (1 family).
Order Epigynæ (7 families).
Order Microspermæ (2 families).
Sub-class DICOTYLEDONEÆ.
Order Thalamifloræ.
Sub-order Ranales (12 families).
Sub-order Parietales (12 families).
Sub-order Polygalales (4 families).
Sub-order Caryophyllales (13 families).
Sub-order Geraniales (11 families).
Sub-order Guttiferales (6 families).
Sub-order Malvales (11 families).
Order Heteromeræ.
Sub-order Primulales (4 families).
Sub-order Ericales (7 families).
Sub-order Ebenales (4 families).
Order Bicarpellatæ.
Sub-order Polemoniales (5 families).
Sub-order Gentianales (6 families).
Sub-order Personales (8 families).
Sub-order Lamiales (4 families).
Order Calycifloræ.
Sub-order Rosales (12 families).
Sub-order Myrtales (9 families).
Sub-order Passiflorales (6 families).
Sub-order Celastrales (13 families).
Sub-order Sapindales (8 families).
Sub-order Umbellales (3 families).
Order Inferæ.
Sub-order Rubiales (2 families).
Sub-order Campanales (3 families).
Sub-order Asterales (4 families).

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BOTANICAL SOCIETY OF AMERICA.

THE most successful meeting which this young but flourishing society has yet held has just closed at Toronto. Although only three years old, both the attendance at the meeting and the great variety and strength of the papers read would be worthy of a much older organization. Every facility was afforded to the Society, through the courtesy of the Local Committee of Arrangements for the meeting of the British Association. The sessions, presided over by Dr. John M. Coulter, were held in the lecture hall of the handsome Biological Building in which this department of the University of Toronto is quartered. Besides the members, there were present a considerable number of British, Canadian and United States botanists. Foreign botanists had been invited by the Council to sit as associate members of the Society for this meeting. Among those present were Professor H. Marshall Ward, Professor F. O. Bower, Mr. Harold Wager, Mr. J. Bretland Farmer and Mr. J. Reynolds Green.

The officers of the Society are elected by ballots distributed by the Secretary by mail, and returned to him by the members. The Council canvassed the vote for officers and announced at the first meeting of the Society that the following had been elected for the year 1898: President, N. L. Britton, of New York; Vice-President, J. C. Arthur, of Lafayette, Ind.; Secretary, C. R. Barnes, of Madison, Wis.; Treasurer, Arthur Hollick, of New York; Councillors, B. L. Robinson, of Cambridge, Mass., and F. V. Coville, of Washington.

A very cordial invitation was sent by the Director and Trustees of the Missouri Botanical Garden urging the Society to hold a meeting in the spring of 1898 at the Garden, as their guests. The Society was obliged reluctantly to decline this invitation, inasmuch as it desires to cooperate with the A. A. A. S. at its semi-centennial next August in Boston, and it was not felt expedient to hold two meetings so close together.

The proposal to amend the constitution so as to reduce the dues met with no favor. It was unanimously laid upon the table, as was also the proposition to establish one or more medals to be awarded for valuable research. The discussion over the last proposition brought out the fact that the Society prefers to expend such funds as it receives for the promotion of research rather than for its reward.

Nine new members were elected. To

secure membership a candidate is first proposed by three members of the Society, who vouch for his eligibility under the constitution, which requires that he be actively engaged in research and the author of at least three contributions to knowledge in botanical lines. After notice of his candidacy has been sent to all members of the Society, written objections to him may be filed with the Secretary by any member. The Council then considers the candidates proposed and recommends such as it thinks proper. These names are then presented to the Society. One-fifth of the votes cast, if negative, will defeat any candidate.

The address of the retiring President, Dr. Charles E. Bessey, of the University of Nebraska, was delivered on Tuesday evening. A full abstract of the address is printed elsewhere in this number.

The following papers were read at the opening sessions on Wednesday:

B. L. ROBINSON: A case of ecblastesis and axial prolification in *Lipidium apetalum*.

J. C. ARTHUR: Movement of protoplasm in cœnocytic hyphæ.

JOHN M. COULTER: Pollen grains and antipodal cells.

FREDERIC E. CLEMENTS (presented by C. E. BESSEY): The transition region of the Caryophyllales.

D. P. PENHALLOW: A revision of the species *Picea* occurring in northeastern America.

EDWARD L. GREENE: Bibliographic Difficulties.

WILLIAM FAWCETT: The botanical gardens of Jamaica. Read by title.

Mr. Fawcett, finding himself unable to be present, sent his paper by post, but it unfortunately was not received in time to be presented. The Council had invited Drs. D. T. MacDougal and D. H. Campbell to present, in connection with this paper, their report upon the island of Jamaica as a site for the proposed tropical laboratory. It was intended that Dr. Fawcett's account of the botanic gardens should present, by means of lantern illustrations, an idea of the facilities already provided there. Although obliged to forego this, Dr. MacDougal spoke of the physical features and climate of the island, and Dr. Campbell discussed its botanical resources. The great interest with which the report was listened to indicates the desire which every botanist feels to have this proposed laboratory in early operation.

The Council also invited Mr. Herbert J. Webber to present before the Society an account of his remarkable discoveries in connection with the fertilization of Zamia. Mr. Webber spoke of the development of the pollen tube and of its spermatozoids and of the way in which they effect the fertilization of the egg. After the meeting Mr. Webber displayed the preparations in which he had made his discoveries. These were examined with the greatest interest.

It will be seen by an inspection of the foregoing list that the papers presented touched all of the great fields of botanical science, with the exception of phyto-geography. Sessions of two hours in the morning and three and a-half in the afternoon were barely sufficient for the completion of the program. At the next meeting, which is to be held in Boston in connection with that of the A. A. A. S., the reading of papers will probably have to be begun a day earlier.

C. R. BARNES,
Secretary.

THE INTERNATIONAL MATHEMATICAL CONGRESS.

THE meeting at Zurich, August 9th–11th, of the International Congress of Mathematicians was in every way a success. More than two hundred members took part. America sent seven representatives, including, however, three Cambridge graduates, now transplanted to Pennsylvania, Profes-

sors Harkness, Morley and Charlotte Scott. The greatest mathematician in the world, Sophus Lie, was not expected; and the greatest French mathematician, Poincaré, though down for a speech, did not come; but the actual program was particularly rich and interesting.

It is very noteworthy that the Congress was divided into five sections: (1) Arithmetic and Algebra; (2) Analysis, and Theory of Functions; (3) Geometry; (4) Mechanics and Mathematical Physics; (5) History and Bibliography.

The program of the first section contained the only title in English: 'On Pasigraphy, its present state and the pasigraphic movement in Italy,' by Ernst Schroeder, of Karlsruhe, author of 'Algebra der Logik.'

The second section contained a title from Z. de Galdeano, whose heroic efforts gave Spain a Journal of Mathematics, now unfortunately dead in the decadence of that beautiful, priest-ridden land.

The program of the third section, the only one consecrated wholly to a single title, Geometry, contained two titles on the non-Euclidean geometry.

Burali: Les postulats pour la geométrie d'Euclide et de Lobatschewsky.

Andrade: 'La statique non euclidienne et diverses formes mécaniques du postulatum d'Euclide.

In Section IV. Stodola treated an important subject, 'Die Beziehungen der Technik zur Mathematik.'

In the fifth section Eneström gave an important discussion of bibliography, a point where the Congress can and will render aid of fundamental importance.

In the first general assembly Rudio spoke on the aim and organization of international mathematical congresses.

It was determined that the next Congress should take place at Paris in 1900, under the auspices of the Société mathématique de France.

As aims were specified: (1) to promote personal relations between mathematicians of different lands; (2) to give, in reports or conferences, an aperçu of the actual state of the divers branches of mathematics, and to treat questions of recognized importance; (3) to deliberate on the problems and organization of future congresses; (4) to treat questions of bibliography, of terminology, etc., on subjects where an *entente international* appears necessary.

Rudio mentioned the yearly issue of an address-book of all mathematicians of the world with indication of their specialties; also of a biographic dictionary of living mathematicians with portraits; also of a literary journal for mathematics.

At the second general assembly Peano gave a conference: 'Logica matematica;' and Felix Klein a conference on teaching higher mathematics.

Three important resolutions were introduced by Vasiliev, of Kazan; Laisant, of Paris, and G. Cantor, of Halle, constituting: (1) a commission for preparation of general reports; (2) a standing bibliographic and terminology commission; (3) a commission to give the congress a permanent character by archives, libraries, stations for correspondence, editing or publishing noteworthy works, etc.

Surely this Congress has proven that it came only in the fullness of time, and that the world moves!

GEORGE BRUCE HALSTED.

AUSTIN, TEXAS.

CURRENT NOTES ON ANTHROPOLOGY.

NEW MUSEUM PUBLICATION.

IN May appeared 'Bulletin Number 1,' of the Free Museum of Science and Art, Philadelphia, a neat octavo of fifty pages, with illustrations. The announcement states that it will be published four times a year, at the subscription price of one dollar

a year. It will contain 'a résumé of the collections made by the Museum, notices of publications referring to museum work, and brief papers by the officers of the Museum.'

The present number contains two such papers, both by myself, one on 'The Pillars of Ben,' which are some curious monoliths in Chiapas, and the other on the Greek *Murmex* (referred to in SCIENCE, April 16, 1897). The notes on the accessions to the Museum are edited by Mr. Stewart Culin, the Director, and are arranged geographically. They present descriptions with cuts of a curious carved pebble from the Delaware valley, a horn arrow-straightener from the Pueblo Indians, name tablets from Corea, an inscribed stone from the thirteenth Egyptian dynasty described by the curator, Mrs. Sara Y. Stevenson, and a number of other interesting specimens.

Such a publication will be not only creditable to the Institution, but will prove a valuable reference work for students in archæology and ethnography.

BOTANY OF THE KLAMATHS.

A RECENT publication of the United States Department of Agriculture is a paper on the plants used by the Klamath Indians of Oregon, by Mr. Frederick V. Coville. It well illustrates how closely the aborigines studied their plant environment and drew their supplies from the vegetable world to the full extent that it was capable of furnishing. Mr. Coville gives the native names for more than a hundred species, all of which were utilized for food, clothing, dyeing, tool-making, 'medicine,' smoking, etc. He succeeded in identifying all the plants in use, and also obtained the native designations from educated Klamaths. He gives these with the diacritic marks used in the Century Dictionary; though it would have been better to have had recourse to the orthography adopted in the Klamath-English Dictionary, published by the United States Geographical Survey in 1890.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

THE *Revue Universelle des Mines* contains in the last number an article by Franz and Büttgenbach on the saline deposits of northern Germany in which a very full description is given of the Stassfurt salt beds. Twenty-five different mineral species are found in these deposits, of which the most important are the sylvine and kainite, so extensively used as fertilizers. The mean thickness of the potassium salt beds is at least twenty meters, and the quantity is estimated at ten billion tons. About three million tons are mined annually, so that at the present rate the supply would last thirty-three centuries.

THE British Home Office has issued an amendment to their order of February last, regarding the keeping of calcium carbid. The new order permits the keeping of quantities less than five pounds provided it is hermetically sealed in closed metal vessels containing not more than one pound each. Unless so kept no quantity whatever may be held without a license. Such restrictions, which are not peculiar to Great Britain, illustrate one method of powerful corporations to stifle competition. It appears that these orders result not so much from the intrinsic danger in calcium carbid as from a fear, on the part of those interested in gas, oil and electric lighting, of rivalry in the use of acetylene.

G. P. DROSSBACH discusses in the *Journal für Gasbeleuchtung* the fact that, while pure thorium oxid has a feeble glow in the Bunsen flame, when a per cent. or less of cerium oxid is present the light is increased ten or twelve fold. He attributes the ac-

tion of the cerium oxid to 'resonance;' the vibrations of the thoria molecules are not synchronous with those of the Bunsen flame, but the presence of a small amount of ceria brings them in accord, as a bit of wax will bring into accord two tuning forks of slightly different pitch. This, Drossbach thinks, is the reason that the mantles for the Welsbach burner must contain ceria as well as thoria.

In the *Ztsch. angewante Chemie*, Lunge and Millberg add a fresh chapter to the controversy regarding the solubility of quartz powder in alkalies. They find that the solubility depends very largely on the fineness of the powder; if fine enough the quartz dissolves completely in both caustic soda and caustic potash on boiling, and the carbonates exercise a decided solvent action. Since clays and similar derived material contain crystallized silica in a state of extremely minute subdivision, there is hence no method now known of accurately determining the proportions of crystallized and amorphous silica present.

In January last at Hannover, after a period of cold weather, there fell on the rising temperature a snow in the form of compact balls. Many of these balls were simple and completely transparent, and consisted of single, simple, spherical crystals. These are described by F. Rinne in the *Jahrbuch für Mineralogie*. Apparently they were crystallized rain drops, but all efforts to make them artificially were without result. They resembled the chondrites of many meteorites, and these also Dr. Rinne finds it impossible to form artificially.

W. Stelzer in the *Pharm. Centr.-Halle* records the examination of several solvents for ozone. Olive oil dissolves 100 volume per cent. of ozone, and this preparation is manufactured by Spranger, of Berlin, under the trade name of 'electron.' Codliver oil takes up 200 volume per cent. ozone, and loses thereby its disagreeable taste and odor. Spranger's 'tincture of ozone' is a solution of ozone in terpene and is probably a chemical compound. One sample examined had lost little of its ozone in fifteen months. Fats and oils which contain no oleic acid and which do not absorb iodin, such as vaseline and other petroleum oils, do not dissolve ozone.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

The prize established by the city of Moscow to be awarded at each International Medical Congress for the medical work of greatest benefit to mankind has been bestowed by the present Congress on M. Henri Dunant, the founder of the Red Cross Society.

Professor von Kölliker, of Würzburg, who recently celebrated his eightieth birthday and the fiftieth anniversary of his appointment as professor, has been awarded the gold Comenius medal of the Imperial Leopold-Carolina Academy of Halle.

It is proposed to erect a tablet in honor of Professor Giuseppi Sanarelli, the discoverer of the microbe of yellow fever, at the University of Sienna, of which he is an alumnus.

The death is announced, at the age of sixty-nine years, of Dr. Jules Bernard Luys, known for his researches on the brain and nervous system, and less favorably for his publications on hypnotism and telepathy.

We regret also to record the death of Mr. Isaac N. Travis, taxidermist and naturalist in the American Museum of Natural History, New York.

Mr. W. W. Woolen proposes to present to the city of Indianapolis fifty-six acres of land for a botanical garden and an ornithological preserve.

The late Marshall Harris bequeathed $60,000 for a public library in Oshkosh, Wis., on condition that an equal amount be collected, and ex-Senator Sawyer, of Wisconsin, has subscribed $25,000 towards the amount.

Emperor Francis Joseph, of Austria, has given his consent to the union of the two great

imperial libraries at Vienna, the Hofbibliothek and the Private Imperial Library. The latter has not hitherto been opened to the public. It possesses a famous collection of portraits, said to exceed 200,000 in number.

As many of the fish brought to the New York Aquarium have died from the effects of injuries received in transit, it has been decided to establish a fish hatchery as one of the departments of the aquarium.

MR. JAMES PERRY has brought suit against the American Museum of Natural History to recover a balance of $400,612.75 with interest, which he alleges to be due him for an archæological and ethnological collection purchased by the Museum.

DR. CHARRIN has been appointed director of a laboratory of experimental medicine which has just been established in the Collège de France.

A BACTERIOLOGICAL Institute has been established at Mons, Belgium, by the Provincial Council, which gives it a subsidy of 6,500 fr. 10,000 fr. have been given to the Institute by an anonymous donor.

THE ninth International Congress of Hygiene and Demography will be held at Madrid from the 10th to the 17th of April of next year.

THE Australasian Chamber of Mines in London are making arrangements for an International Mining Machinery and Metallurgical Exhibition to be held in London in 1899, in time for the exhibits to be forwarded to the Paris Exposition in 1900.

THE partial cessation of the plague at Bombay has been followed by an epidemic of cholera, which seems not to have attracted much attention. During the last week for which advices have been received there were 220 deaths from cholera. There were still during that week 18 deaths from the plague.

THE British Medical Association held its sixty-fifth annual meeting at Montreal last week, following the program which has been already published in this JOURNAL. At the first session, on the afternoon of Tuesday, August 31st, addresses of welcome were made by Mr. Wilson Smith, mayor of the city; by Mr. Adolphus Chapleau, Lieutenant-General of the Province of Quebec, and by the Earl of Aberdeen, Governor-General of Canada, and Dr. T. G. Roddick delivered the President's address. Dr. Roddick, after welcoming the members and guests, referred to the history of the Association from its foundation at the initiative of Sir Charles Hastings in 1832, and then considered especially the Canadian climatic conditions and health resorts, and concluded with a review of medical education and medical legislation in Canada. On the following afternoons, Wednesday, Thursday and Friday, the general addresses were given. The address in medicine was given by Professor William Osler, of Johns Hopkins University, who, it appears, is still a Canadian citizen. His address was entitled 'British Medicine in Greater Britain,' and took a wide survey, including a comparison of the Greek and British races and the influence of the former on the latter. The address in surgery was by Dr. W. Mitchell Banks, Liverpool, who confined his address to the work accomplished by military surgeons. The address on public medicine, given on Friday afternoon, was by Dr. H. M. Biggs. A general address was given by Professor Charles Richet, who chose as his subject 'The work of Pasteur and the Modern Conception of Medicine.' During the mornings sessions of the Sections were held. The Proceedings, to be published in the *British Medical Journal*, will bear witness to many important addresses, papers and discussions. At a special session of convocation McGill University conferred the honorary degree of LL.D. on Lord Lister, Sir W. Turner and Drs. Broadbent, Gaskill, McAllister, Watson Cheyne, Henry Barnes and A. G. Wheelhouse.

THE continuity of national associations for the advancement of science is exemplified by the fact that the German Association, which meets in Brunswick in September, has been invited to make an excursion to Pyrmont, where its seventeenth meeting was held in 1839.

EIGHT hundred geologists were in attendance at the recent International Geological Congress, of whom about two hundred and fifty were Russians. No reports of the meetings have been cabled to the daily papers, but we hope to pub-

lish shortly an article on the work of the Congress.

THE American Social Science Association held its general meeting in Saratoga last week. Mr. Frank B. Sanborn, who for more than twenty years has been Secretary of the Association, on resigning, presented a report tracing the history of the Association, which he thought was not accomplishing as much as it should. A number of interesting papers were, however, presented at the Saratoga meeting. Judge Simeon E. Baldwin, New Haven, was elected President and Mr. F. Stanley Root, New Haven, Secretary.

THE French government proposes to send an official expedition to Egypt, starting from Marseilles on October 28, 1897, and returning in the month of December. The expedition will be under the direction of Professor Révillont. Volunteers willing to pay their own expenses will be allowed to join. The arrangements are in the charge of M. Maurice Junot, of Rue de Rome, Paris.

WE learn from *Natural Science* that Mr. George Murray and Mr. V. H. Blackman have returned from their trip to Panama, after a successful and profitable voyage. They have obtained a large quantity of plankton containing many new specimens, which will shortly be worked out, and have made numerous interesting observations on living forms. They spent two or three days in Jamaica on the way.

PROFESSOR KOCH, so it is reported, is about to return to South Africa to carry out further experiments in relation to rinderpest.

PROFESSOR CHARLES S. PROSSER, of Union College, has been engaged during the past summer in mapping and describing the Upper Devonian formations of southeastern New York for the New York Geological Survey.

THE *Botanical Gazette* states that Drs. Farlow and Coulter will make, during the winter, a further examination in the West Indies with a view to finding a suitable site for a botanical tropical laboratory.

AN illustrated monthly of popular botany, *The Plant World*, will be published by Willard N. Clute & Co., Binghamton, N. Y., beginning October 1st. The editor is Dr. F. H. Knowlton, United States National Museum.

ON September 3rd Professor Nef gave a public address at the University of Chicago on 'The Problems of Organic Chemistry,' and on September 7th and 8th Professor Lester F. Ward was announced to give two lectures, one on 'The Founder of Sociology, Auguste Comte,' the other on 'Nature and Nurture.'

PROFESSOR SKLAREK, Halle, calls our attention to the fact that among the publications of the late W. Preyer, given on page 252 above, 'The Five Senses of Man' was included. The book is by Professor J. Bernstein, of Halle.

WE are glad to receive the information that 'The Louisiana Society of Naturalists' was organized on July 22d. The Society will not only undertake to encourage and advance the study of natural science, but will also establish a library and a museum, and will publish its proceedings. The Society is to be incorporated and starts with about 45 members, nearly all of whom are workers in some branch of natural science. The first officers are:

President, Professor J. H. Dillard, Tulane University; *Vice-Presidents*, Mr. G. R. Westfeldt, Professor H. A. Morgan, Louisiana State University, Rev. A. B. Langlois; *Secretary-Treasurer*, Mr. E. Foster; *Executive Committee*, Professor J. H. Dillard, Professor G. E. Beyer, Mr. G. R. Westfeld, Dr. O. Joachim, Professor H. A. Morgan, Mr. J. C. Smith, Rev. A. B. Langlois, Mr. E. Foster.

MR. H. C. FAIRBANKS, of Sibley College, while reconstructing a gas-engine, observed a singular though probably not exceptional phenomenon which, so far as known, has not been previously described. The machine exhibited a great loss of heater-efficiency, which was unaccounted for and was not affected by any changes made in the process of general repair. Finally it was suspected that the conductivity of the metal of the cast iron 'fire-pot' had been impaired by oxidation or otherwise, and it was replaced by a new one. The engine at once started off at full power and regained its original efficiency.

At the request of the daughters of George Bond, Professor Holden, Director of the Lick Observatory, has undertaken to arrange the manuscript material in their hands in an orderly form. The work will be entitled 'Memorials of William Cranch Bond, Director of the Harvard College Observatory, 1840–59, and of his Son, George Phillips Bond, Director of the Harvard College Observatory, 1859–65,' and will be sold for two dollars by C. A. Murdock &. Co., 532 Clay Street, San Francisco, and by Lemcke & Büchner, 812 Broadway, New York City. The contents are: Chapter I., Life of W. C. Bond, 1789–1859; II., Life of G. P. Bond, 1824–1865; III., Selections from the Diaries of George Bond; IV., Selections from the Correspondence of George Bond; V., Account of the Scientific Work of the Bonds; Appendices, giving a complete list of their published writings; and Index of Proper Names. The book will be well illustrated. It is hoped by the kindness of Professor E. C. Pickering, Director of the Harvard College Observatory, to reproduce two fine steel engravings of the Great Comet of 1858 and of the nebula of *Orion*, from the plates of the *Annals* H. C. O.

The British Museum (Natural History) has acquired, says *Natural Science*, the Savin collection of vertebrate remains from the Norfolk forest-bed and other deposits of that coast. A collection of gault fossils from the 300-feet level of the shaft of the Dover coal-fields has also been received, and it is understood that the whole of the remains from this very interesting and important shaft will be preserved for the national collections, as a typical reference series for the underground geology of the southeast of England.

UNIVERSITY AND EDUCATIONAL NEWS.

At the meeting of the corporation of Brown University on September 1st statements were presented by the Conference Committee and by President Andrews. He states that he has been reticent and careful in expressing views on the free coinage of silver by the United States; that he would discountenance any proposal which, in his judgment, bids fair to place the country's finances on a monetary basis of silver alone; that he has always insisted that the principal and interest of our public debt should be paid in gold, and that he had only publicly advocated that form of bimetallism which was a part of the Republican platform in the last election. He states further that his resignation was made on account of his desire to regard the University's interests and that the publication of the Committee's minutes did not proceed from his motion. As President Andrews simply cleared himself from the charges made by the Conference Committee and did not attempt to defend reasonable freedom of speech, we are especially glad that the corporation, in asking him to withdraw his resignation, stated that they did this "especially desiring to avoid, in the conduct of the University, the imputation even of the consideration of party questions, or of the dominance of any class, but that in the language of its charter, 'In this liberal and catholic institution all members whereof shall enjoy full, free, absolute and uninterrupted liberty of conscience,' which includes freedom of thought and expression, it cannot feel that the divergence of views upon the 'silver question' and of its effects upon the University between you and the members of the corporation is an adequate cause of separation between us." President Andrews has not yet made a reply to the letter from the corporation, but it is understood that he will not withdraw his resignation.

The executor of the will of the late Mrs. Lucy Fayerweather has brought suit in the United States Courts with a view to setting aside the decision of the State Courts awarding the estate of the late Daniel B. Fayerweather to the colleges to which it was bequeathed. The heirs-at-law are also contesting the will of the late William Lampson, who left most of his estate to Yale University, alleging that he was of unsound mind. We wish that the moral insanity which leads people to make these contests disqualified them at law from inheriting any money.

Dr. D. K. Pearson has presented Beloit college with a dormitory costing $30,000.

Yale University receives $5,000 by the will

of the late Miss Julia Lockwood for the foundation of a scholarship.

FUNDS given by friends of Smith College for a new dormitory will, it is said, be used for a chemical laboratory. It is hoped to secure some $30,000 for the building.

WE regret that the announcement made to the effect that Mr. S. B. Brownell had presented Barnard College with a building for a dormitory is incorrect. It had its origin probably in the fact that plans have been filed for the west wing of the new buildings of Barnard College, given by Mrs. Fiske, which will be temporarily used as a dormitory.

THE sixth annual summer school held at the University of Minnesota, Minneapolis, has just closed one of the most successful sessions of its history. The school is organized in two sections, an elementary section and a university section. The enrollment of the university section in the several scientific subjects was as follows:

General Chemistry; Professor Frankforter.......	40
Entomology; Mr. Oestlund	14
General Geology; Professor Hall................	38
Physiology; Professor Nachtrieb................	18
Plant Physiology; Mr. Ramaley................	12
Physics; Professor Jones.......................	30

AT the recent Zionist conference for the colonization of Palestine by the Jews at Bâle, a commission was appointed to report upon the establishment of a university at Jerusalem.

A SPECIAL commission will meet shortly at St. Petersburg to discuss the introduction of universal and compulsory education in Russia.

DISCUSSION AND CORRESPONDENCE.

OBSERVATIONS OF THE PASSAGE OF MIGRATING BIRDS ACROSS THE LUNAR DISK ON THE NIGHTS OF SEPTEMBER 23 AND 24, 1896.

THE time is at hand when records of the transit of migrating birds across the moon's face may be secured, and I desire to put on record the following measurements, made last year, which may be of assistance to observers. All records show that the migration takes place at night, at least in the case of the smaller birds, and the dates immediately preceding and following the full of the Moon, with probably a certain amount of latitude for weather and temperature, are the ones chosen.

The instrument used in these observations was the finder of the equatorial of the Ladd Observatory. Its aperture is 4 inches, and the magnifying power was 40 diameters. When focussed on the Moon, the eye-piece had to be pulled out 1.74 inches, and the principal focal length was 4 ft. 9.59 ins.

The observations may be divided into three groups:

a. 7:45 to 8:15 Eastern M. T., Sept. 23d.
b. 8:15 to 9:15 " " " "
c. 7:45 to 8:15 " " " 24th.

The apparent altitudes and azimuths of the Moon were:

Sept. 23, 7:45,	altitude =	19°.0,	azimuth	N. 88°.0 E.
" " 8:15,	"	24°.6,	"	S. 87°.1 E.
" " 9:15,	"	35°.4,	"	S. 76°.8 E.
Sept. 24, 7:45,	"	14°.6,	"	N. 79°.9 E.
" " 8:15,	"	19°.8,	"	N. 82°.3 E.

The mean altitudes were:

Period *a* (½ hour) 21°.8 above the true horizon.
b (1 hour) 30°.0 " " " "
c (½ hour) 17°.2 " " " "

Journal of Observations.

The flights were so rapid that it was thought best to attempt nothing more than hasty comparisons with prominent lunar features in order to get estimates of the apparent size of the birds. Three points were selected for this purpose:

Aristarchus	(longer inside diam.) approximately	0′.3
Copernicus	" " " "	0′.6
Mare Crisium	" " " "	3′.0

Times were estimated by a chronometer audibly beating half seconds.

First night, September 23d. From 7:45 to 8:15 scarcely a minute passed without the passage of several birds, in groups numbering from one to five or six in immediate succession. It was obvious that the birds traveled in little companies. After perhaps a minute without any, one would appear, followed by four or five more in the next ten seconds—perhaps members of one family keeping near each other to relieve the loneliness of the long journey. The great majority traveled from north to south. Few deviated more than 20° or 30° from this

direction, and none were seen to move in the opposite direction. The majority were less than one-half second in crossing the Moon's disk (diameter $= 29'.5$). Quite a considerable number traversed the disk in 0.1 or 0.2 second. Few were as slow as 1 second and only one required 2 to 3 seconds. In this case the trajectory may have approached the line of sight. A majority appeared very small, not larger than Aristarchus (or $0'.3$); few equaled Copernicus (or $0'.6$); one only had a spread of wings equal to the longer diameter of the Mare Crisium (or $3'.0$). In this case the wings were sharply seen when the focus was $0'.21$ longer than the principal focal length. For most of the birds the focus scarcely required changing from that for the Moon's surface. Some of the swiftest flights were made by birds of the smallest apparent size.

After 8:15, as the moon rose higher (altitude 25° to 35°), the number of birds diminished; and at 9:15 intervals of 2 to 5 minutes elapsed between successive birds. The travelers no longer came in groups. Evidently the angular area of the Moon no longer filled the distance between the mean trajectories of the members of a group. The average size was larger, more nearly that of Copernicus; one bird, badly out of focus, equaled the Mare Crisium in size.

At 9:15 the observations were discontinued, as the intervals were continually getting longer.

Second night, September 24th. The watch was commenced at 7:45 with the Moon at a lower altitude than on the previous evening. The birds were less numerous, and after a half hour at 8:15, clouds began to gather, which soon completely covered the sky. In this half hour not over a dozen birds were seen. Two of these moved from south to north, traversing the diameter of the lunar disk in about 3 seconds. These were the only birds seen flying north on either evening, and the slowness of their speed indicates that they were probably moving more nearly in the line of sight (or east and west). Every flutter of the wings was plainly visible with the telescope at its lunar focus. One bird, of an expanse equal to that of the Mare Serenitatis, was blurred beyond recognition, and was evidently close at hand. One had the wavering flight of the goldfinch, and a diameter equaling that of Aristarchus (or $0.'3$).

It seems possible that the prospect of cloudy weather may have deterred the migrating birds from starting on this evening. The interval from sunset to moonrise was also longer (48 minutes as against 24 minutes on the previous evening).

I now proceed to the reduction of these estimates, taking first the case of the single bird whose motion was slow enough to permit an exact adjustment of the focus, the focal length having to be increased for the bird from 57.59 inches to 57.80 inches. The bird was nearly end on. Assuming its real spread to have been 12 inches, and comparing its estimated angular diameter with the radius of a circle we have its

$$\text{distance} = \frac{3437.7}{3.0} = 1146 \text{ feet.}$$

Reversing the process, we have from the law of lenses,

$$\text{Conjugate focal length} = 1321 \text{ feet,}$$

which would make the spread

$$\frac{1321}{1146} + 12 = 13.8 \text{ inches.}$$

The spread of a robin is 16 inches, and the bird may have been of the size of a thrush.

The majority of the flights were at right angles to the line of sight, and the lengths of our smaller birds (warblers, flycatchers, etc.) being from 5 to 7 inches, I shall assume an average true size of 6 inches, and an apparent (angular) dimension of $0'.3$ in periods a and c, with a mean altitude of 20°; while towards the close of period b, the altitude had increased to 35°, and the mean apparent angular diameter began to approach $0'.6$. This gives for distances

$$\text{(a) and (c)} \quad \frac{3437.7}{0.3} \times \tfrac{1}{2} = 5729.5 \text{ feet,}$$

$$\text{(b)} \quad \frac{3437.7}{0.6} \times \tfrac{1}{2} = 2864.8 \text{ feet,}$$

and for the heights of the birds above the observer's level (235 feet above sea-level,

$$\text{(a) and (c)} \quad 5729.5 \times \sin 20° = 1959.6 \text{ feet,}$$

$$\text{(b)} \quad 2864.8 \times \sin 35° = 1643.2 \text{ feet.}$$

These measurements indicate an altitude of about 200 feet above sea-level as the average

height of the migratory flight of the smaller birds. Of course, if the dimensions were greater than those assumed, the altitudes must be correspondingly increased, but the largest bird, whose distance was determined by the focal adjustment already described, had an altitude above sea-level of

$$(1321 \times \sin 20^\circ) + 235 = 687 \text{ feet},$$

and was certainly much lower than the smaller birds.

The speeds can be roughly estimated from the times of transversing the lunar diameter (29′.5). This time was on the average about one-half second, giving

$$\begin{aligned} \text{velocity} &= \frac{29.5}{0.3} \times \tfrac{1}{2} \text{ ft. per } \tfrac{1}{2} \text{ sec.} \\ &= 98.4 \text{ feet per second,} \\ &= 67 \text{ miles per hour.} \end{aligned}$$

But the swiftest flights, with every allowance for the difficulty of their estimation, were at least twice as rapid, which, if the distance were the same, would imply a velocity of at least 134 miles per hour. Some of the swifter trajectories may have belonged to very small birds at lower altitudes and smaller distances, but I have already assumed a size which is nearly that of our smallest birds. Any increase in the estimate of size enlarges that of distance and velocity. I am not ready to admit the probability of an error of judgment in the estimation of apparent sizes of as much as 100 per cent, and I have already increased the more vulnerable time-estimate for the swiftest flight from 0.15 to 0.25 seconds. Judging from the appearance of many of these darting specks, and with every allowance for errors of estimation, I am of the opinion that some of these apparent velocities are real, and that certain small birds (not the swifter swallows, humming birds and swifts, for these have all gone a month before the dates in question) can maintain a flight of 100 miles per hour without being stripped of their feathers.

In SCIENCE for January 1, 1897 (Vol. 5 N. S., p. 26), Mr. H. H. Clayton gives the height of a flock of ducks, flying southwest in December, as 958 feet above the Neponset valley, and the velocity as 47.8 miles per hour; and in SCIENCE for April 9, 1897 (Vol. 5 N. S., p. 585), the same observer gives the height for a flock of geese, migrating northeastward in March, as 905 feet above the Neponset valley, or 960 feet above sea-level, and the velocity of flight as 44.3 miles per hour. It thus appears probable that the larger birds migrate at a lower altitude than the smaller ones, and at not over half the speed of the swiftest flights.

Even more remarkable than the speed of migration are the psychological problems involved in these semi-annual movements of enormous multitudes of creatures. There was, to me, something awe-inspiring in this spectacle of a throng of tiny beings launching out into the unknown deep, in pale moonlight and through the hours commonly given to sleep, flitting swiftly and unerringly to a far-off goal, while beneath, and heeding them not, slumbered a dreaming world. What mighty impulse of daring is this which can transform a timorous sparrow, content all day to hop from bough to bough near to its nest and mate, into a bold adventurer, starting out, Columbus-like, on a voyage of discovery? If it were a matter of individual courage and wisdom, we men might shrink from the comparison—the ardor, the inerrancy, are so superhuman. Rather must we liken the migratory impulse to an irresistible force, drawing the winged wayfarers into its current, and bearing them they know not whither. It must not be forgotten that for the young birds, constituting no small number of the host, this journey is absolutely new, and not the result of experience. If the movement were the result of knowledge and trust, we might well exclaim: Oh to be as confident of eternal beneficence, and as full of foresight as are these little wanderers!

FRANK W. VERY.

LADD OBSERVATORY,
PROVIDENCE, R. I., September 3, 1897.

SCIENTIFIC LITERATURE.

Year-book of the United States Department of Agriculture, 1896. [1897.]

In the preface to this volume, Mr. Charles W. Dabney, Jr., remarks that it falls far short of the ideal set for it, and regrets that it was not possible to give it more 'editorial revision' than it has received. We may all hope with

Mr. Dabney that each year-book will be better than its predecessors; but it seems to us that there is nothing to apologize for in the present work; and as for 'editorial revision,' we believe the mostly eminent writers of the articles it contains know perfectly well what they are about, and that revision of any sort would be an injury to them and a detriment to the volume. It is the proper work of the editor to obtain, select and arrange suitable articles for the volume, and this Mr. Dabney has done in a most admirable manner; but the time has come for scientific workers to insist on having their manuscripts printed as written, instead of being changed and even interlarded with gross errors, as is sometimes the case.*

The frontispiece of the year-book appropriately consists of the portraits of Senator Morrill and Hon. Wm. H. Hatch; the fine face of Senator Morrill is especially welcome, and will not easily be forgotten, even by those who have only seen the picture. The first part of the book, the report of Secretary Morton, has long been before the public, and need not be specially discussed now. It is, however, a document that should be read by all who take any interest in agriculture or agricultural science. The observations on the free distribution of seeds, and on the affairs of the experiment stations, will be endorsed by nearly all those who are not connected with the 'political machine.' Whatever opinion one may hold as to the propriety of the free distribution of seeds by the government, the present system must be condemned as wasteful and unjust. Whatever views one may have as to the desirability of local control, it cannot be permitted for experiment station authorities to break the letter or the spirit of the law, or waste the funds entrusted to them. The people of the United States, after all, are partners in business, and cannot wholly escape responsibility for one another's actions. It is, besides, a serious injury to the majority of stations, which are admirably applying their funds, that the minority should be able to drag the name of the experiment stations in the mud.

* Some readers will think this too strong a statement, but we could readily give the facts of the cases we have in mind. It may be added that those responsible for the errors were scientific experts of excellent standing, as learned as any that could be obtained, but they did not happen to know everything. The publications were not those of the Department of Agriculture.

The body of the book consists of thirty articles bearing on as many problems of agriculture and kindred arts, and while probably no living person is competent to sit in critical judgment on such a varied assortment, it will not be questioned that each essay is of great value. We think that any educated citizen of this country, turning over the pages, cannot fail to feel very proud of the volume, as affording evidence of the highly satisfactory condition of at least one of the great departments of the government. If he is acquainted with the official agricultural publications of other countries he will have the further satisfaction of knowing that the United States is leading, not following, in the matter of educating the agricultural population, for the year-book is as truly an instrument of education as any college or university.

Mr. H. J. Webber's article on the 'Influence of Environment in the Origination of Plant Varieties' is very interesting, though he does not directly meet the question whether acquired characters are transmissible, while apparently being of that opinion. Dr. C. W. Stiles' essay on 'The Country Slaughterhouse as a Factor in the Spread of Disease' is very opportune. Mr. Marlatt's 'Insect Control in California' is an extremely valuable article and will help to settle some hot disputes between entomologists and horticulturists. 'The Superior Value of Larger Heavy seed,' by Messrs. G. H. Hicks and J.C. Dabney, is not only of much practical value, but of considerable theoretical interest. It is impossible now to discuss the remaining articles, but special attention must be called to 'An Ideal Department of Agriculture and Industries,' by M. E. Tisserand, Councillor of State and Director of Agriculture in France. This is a most suggestive and interesting article, and we should express our thanks to Mr. Dabney for arranging for its publication in the year-book.

T. D. A. COCKERELL.

MESILLA, N. M.,
August 10, 1897.

SCIENCE

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FRIDAY, SEPTEMBER 17, 1897.

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*THE SCIENCE OF HUMANITY.**

I.

HUMANITY is a favorite theme of poet and philosopher, novelist and historian, dramatist and moralist. The changes rung on the theme run the entire gamut of human feeling and thinking; its burden is caught in song and story and crystallized in books, and no sweeter strains have ever been sung, no grander scenes enacted, no nobler lines penned, than those fertilized by the touch of human (and solely human) nature that makes the whole world kin..

The chief subject of thought among all races is humanity in some of its numberless aspects; the chief part of the literature of civilized nations relates to humanity; the chief activities of all men are inspired by humanity. Yet—and this is a modern marvel—for the greater part the thought is vague, the literature random, the activity unorganized; *i. e*, this most important of all subjects-matter and objects-matter in human ken has hardly been brought into the domain of that definite knowledge called science. It is meet to inquire why this is so; and, to the end that the inquiry may be answered clearly, it is needful first to define humanity and then to consider what knowledge is and the way in which science has come to be; later the half-formed science

*Vice-Presidential address before Section H of the American Association for the Advancement of Science, delivered at Detroit, August 9, 1897.

of that which is proper to intellectual man and most important to his kind may be outlined.

II.

According to the lexicographer, humanity denotes: (1) the condition or quality of being human; (2) the character of being humane; (3) the character of being well bred; (4) mankind collectively, and (5) secular learning or literature.* The fourth of these definitions connotes Man—the genus Homo, object-matter of the broad science of anthropology—viewed in a distinct way, *i. e.*, as a mass or composite body rather than discrete individuals. The fifth definition connotes but a limited field in a vast domain, and is scholastic, if not archaic; with this sense the term is chiefly used in opposition to divinity, often in the plural form (though there is good precedent for the use of this plural form in a more general and at the same time a more definite sense).† The first three definitions connote a wide range of attributes of Man which, albeit well recognized by all intelligent people, are rarely reckoned among the objects-matter of anthropology, seldom included within the pale of science; yet it is these attributes that especially distinguish Man and set him apart from the mineral, vegetal and animal worlds, and exalt him above the rocks and plants and beasts of simple nature.

Although commonplace, these definitions are worthy of careful consideration in that they summarize the substance of intelligent thought since the beginning of writing—indeed, since its own beginning in the remote unwritten past—and particularly during the era of unprecedented intellectual activity and scientific progress dating from the issue of Bacon's *Novum Organum;* they carry the wisdom of the ages, and especially of these later days during which wisdom prevails as never before. Viewed separately or in connection with contemporary definitions relating to mankind, they indicate general (although vague) recognition of certain specific attributes of Man, not as an animal, but as an ill-defined something known as a human being. When the history of thought condensed into the set phrases of the lexicographer is scanned, it is found that bitter controversy has been engendered by the diverse aspects of Man as seen from opposite sides; the disputants, like the storied knights of old, have admired the object, one as silver and the other as gold, and have done doughty battle in defense of their one-sided vision; the biologist, with eyes trained by observation and reason sharpened by long study of living things, sees the silvern side and sounds trumpet for man as an animal, while the litterateur and statesman and philanthropist are half-dazzled by the golden glory of Man as a thing supernal. The fair conclusion is that both are right as to what they see and both wrong as to what they fail to see; and in the light of this conclusion it is clear—if the general judgment of the body of thinkers is worth anything—that man has an animal basis on which a noble superstructure is borne. The definitions of the lexicographer, who voices the thought of the world, show that among general thinkers the idea of humanity prevails over the idea of animality, while the current literature of science indicates that the idea of animality is dominant in scientific circles; indeed, some writers on anthropology, the Science of Man, restrict the term to knowledge of the mammalian order Bimana, a limitation excluding the essential characteristics of Man as a thoughtful and emotional being and as an integral part of a collective and interdependent assemblage. Any attempt to harmonize these opposing ideas must begin with definite

* Condensed and rearranged from the 'Standard' and 'Century' Dictionaries.

† *E. g.*, in 'The Humanities,' by J. W. Powell; SCIENCE, New Series, Vol. I., 1895, pp. 15–18.

statements of the meaning attached to the essential term by more catholic anthropologists. So Humanity may be defined, by exclusion, as the condition or quality or character of possessing attributes distinct from those of animals, vegetals and minerals; or, by inclusion, as (1) attributes or characteristics confined to human beings, comprising (*a*) the condition or quality of being human, *i. e.*, of acting, feeling and thinking after the manner of human beings, (*b*) the character of being humane, and (*c*) the character of being well bred; (2) mankind collectively; (3) secular learning and literature.

The supreme importance of humanity as thus defined is indicated by the fact that it is the foremost subject-matter of thought and speech and literature among all peoples, its prominence increasing from savagery through barbarism and civilization and culminating in enlightenment. The essential distinctness of humanity as thus defined appears when its serial relations to the other primary objects-matter of knowledge are considered. Just as living things rise above the mineral world by the possession of vitality, and just as animals rise above plants by the possession of motility, so do human beings rise above all other things by the possession of specific attributes rooting in mentality and maturing in the complex activities of collective life; or just as inorganic matter is the basis for the essentially distinct organic existence, so organic matter and processes form the basis for the essentially distinct superorganic activities of human existence. The importance and distinctness of humanity are, indeed, such that it behooves naturalists to recognize a fourth realm or world—to extend science from the great realms of the mineral, the vegetal and the animal into the incomparably broader and richer realm of the purely human; and this extension is the chief end of modern anthropology.

III.

Human knowledge is constantly increasing. The body or aggregate of knowledge is imponderable, and may not be counted or measured or weighed; yet it is an entity of prime importance and of universal recognition. Itself indefinite and varying from mind to mind, the sum of knowledge may be divided, albeit roughly, and analyzed, albeit crudely, and the days and years and centuries of its progress among men and peoples may be so studied that its tendencies, and perhaps even the laws of its growth, may be followed, albeit slowly and uncertainly. Although so indefinite, it is well worth while to try, and try again and still again, to analyze knowledge and trace its progress; for knowledge is the end and aim of intelligence, and human progress is measured not more by increase in knowledge of things than by increase in knowledge of knowledge.

Many students have found it convenient to divide or classify knowledge as individual and common, general and special, empiric and scientific, deductive and inductive, etc., according to the point of view; and these divisions are of use in that they represent first steps in analysis, though it is to be remembered that they are more or less vague or arbitrary, one or both. It may not be bootless slightly to extend this provisional analysis in order to trace more clearly the lines and stages in the growth of intellectual product.

For the sake of gaining clear ideas of relation, it is sometimes useful to project perception by the aid of mental imagery, and thereby to visualize the invisible in the eye of the mind. So the great aggregate of knowledge is often likened unto a numerical sum, or a reservoir or river fed by many affluents; but a better figure may be found in scientific ideation, and the imponderable body may be pictured as an indefinite nebula or plasma, constantly

growing by accretion and constantly undergoing internal change. This plasma may best be portrayed as for the most part unorganized, with partially or completely organized nuclei and nodes and processes here and there; and there is a certain fitness in conceiving the organized tracts as near the surface where the interactions between external and internal are direct and continuous. In this way the intellectual product of the world may be likened unto a nebula, a cloud gathering in a supersaturated solution, an amœba, or a brain; it may be viewed as a chaos more or less advanced on the way toward cosmos. The image is ideal; it serves merely as an aid in grasping and formulating widespread notions concerning knowledge as an elusive and intangible yet vigorously real and important something; but it is not essential to correct understanding of the main facts in the growth of knowledge.

Knowledge is born of the individual brain fertilized by indirect contact with other brains, and is given unto others with a degree of freedom varying with the disposition of the individual and the perfection of his mechanism for conveying thought —gesture, picture, speech, writing, printing; the growth of knowledge keeps even pace with the acquisition of structures and devices for its expression; and it is a pleasant and significant fact that in general the disposition to dispense knowledge grows strong and active just as the dispensing mechanism improves, though usually lagging a little behind, much as the verdure follows the vernal shower. So the stage of individual knowledge is initial, the stage of common knowledge consequent; so also individual knowledge is barren and unproductive until turned into the general fund to increase and multiply an hundredfold; and so, too, there is progressive growth from the initial stage of individual discovery or invention, through many ill-defined yet successively higher and higher steps, well toward the mature stage of general possession. It is needful to observe that the body of general knowledge can never quite equal the aggregate knowledge possessed by individuals; although stimulated by others, each active individual knows something more than he is able to tell, be he never so free in disposition and facile in expression; and it is the never-ending process of coining and issuing and exchanging the precious product of the cerebral crucible that gives rise to intellectual property-right, and at the same time enriches the great plasma of knowledge and maintains the activity essential to its existence. It follows—and this scientific certitude may be commended to a certain class of socialistic schemers—that the relation between individual knowledge and general knowledge is asymptotic, in that, although the latter constantly approaches, it never can reach the former; indeed, if general knowledge were ever to overtake individual knowledge, through suspension of the laws of intellectuality (undoubtedly immutable as those of vitality), the special province of mental activity would be annihilated and the body of knowledge would sink into quiescence—and, in the intellectual as in the vital, quiescence is death.

As knowledge is produced and given unto others, the freedom of giving is governed by numberless conditions, including the perfection or imperfection of the mechanism for expression, the avidity or indifference of the chosen beneficiaries, and the price fixed by custom; and so it happens that certain discoveries and inventions are directly communicated only to limited groups of individuals, who thereby accumulate special knowledge. In this way cliques and trades and guilds arise and the germ of caste is planted; in this way, too, specialists grow up through the indifference of the masses and their inability to keep pace

with the investigator whose energies are directed along a single line; and eventually, among the most enlightened peoples, special societies are formed for the purpose of fostering or diffusing discovery and invention and thereby rounding out the fecund plasma of human knowledge. It may be noted that special knowledge is nearly as barren and unproductive as individual knowledge, and is soon blasted by the poison of its own egoism, unless the richer part of its substance is guided toward the general mass, to do work as it advances; for it is by no means to be forgotten that the activity of the great body of knowledge culminates in the province or zone of special knowledge, and that herein lies the leaven that leavens the whole.

During recent centuries, and especially during recent decades, specialists engaged in creating knowledge have studied knowledge itself in the hope of learning its nature and origin; and most of these students have become convinced that the basis of real knowledge is found in the facts of the cosmos as revealed by observation or established by experimentation. So the acquisition of knowledge begins with noting particular facts and advances to assembling or grouping these facts, *i. e.*, proceeds from observation to generalization; the second process involves the elimination of the unlike or incongruous, and this leads to discrimination and to the recognition of analogies. In general terms, and somewhat provisionally, it may be said that the analogies so recognized constitute laws of occurrence, which may themselves be generalized, and that the requisite discrimination of analogies leads to the recognition of homologies, or laws of occurrence and sequence combined; the framing of analogies and homologies being legitimate inference, which develops in hypothesis and matures in theory or doctrine to be finally formulated in laws or principles. Knowledge produced in this regular and simple manner is commonly called inductive, though there is always a deductive element coming over from that general intellectual possession by which even the closest specialist is guided in greater or less measure. Now, it is to be noted that acquisition of knowledge is largely spontaneous and unconscious; that apperception lags far behind perception, and that only the adolescent and mature among men and peoples are clearly conscious of their own mental processes, or, indeed, of the existence of mental process; it follows that most of the processes just outlined are ill-recognized or not recognized at all, even by the very makers of knowledge. Moreover, the later steps in intellectual acquisition are commonly the first to be consciously noted, so that the majority of men, even unto the present day, have failed to recognize the true source of real knowledge, and have appealed to all manner of mysterious and extravagant sources for part or all of the intellectual wealth of the world; for while the more complex processes alone were recognized inference was exalted and observation was contemned, subtle imagining ran riot and overshadowed sober reason, and scholastic learning—which the practical makers of progress fortunately ignored or repudiated—grew into a labyrinth of deductions from vain postulates and hazy lucubrations. A new epoch dawned when Bacon formulated the inductive method, though he knew not that the method was old as the human mind and that he but recognized that which all men do, whether consciously or unconsciously. Reviewing the course of intellectual acquisition from observation through generalization and inference and theory unto laws of occurrence and sequence, knowledge may be classified by degree of development, and the simpler and more primitive (whether burdened by assumption or not) may be called empiric,

while the more definitely organized product of special study may be called scientific; and, remembering that the processes of acquiring knowledge are partly unconscious, that portion which is organized unconsciously may be classed as common sense, or sagacity, or the wisdom of experience, while the consciously organized portion may be called science. This summary of the mode of organizing knowledge may be trite, yet it serves to show that the methods of the student of humanity are in no wise different from those pursued in the physical and natural sciences.

In brief, knowledge is ever passing from the individual to the common and from the special to the general, and thereby its quantity is constantly increased and its utility extended; during recent times it is passing also from the empiric to the scientific, and therefore its quality is improved and its beneficence multiplied.

IV.

When the history of the class of knowledge called science is scanned certain tendencies or directions of growth are perceived, and scrutiny shows that these tendencies are in harmony with the course of development of knowledge in general.

1. In general, observation and research begin with the rare or remote and proceed toward the common and the near. This tendency is revealed when the several branches of science are compared. Perhaps the oldest science is Mathematics, which began before history, so that its origin is obscure and cannot certainly be traced to definite objective basis; but the nearly contemporary and closely related science of Astronomy rested on observation of the celestial bodies, though the observation was long clouded by the mysticism of astrology. Then, as wits were sharpened by mathematical research and astronomical observation, exact knowledge was gradually brought down to nearer bodies and under the guidance of everyday observation, and thus the science of Physics arose so gradually and inconspicuously that its early history is lost. Later, shrewd hermits and beldams wrought magic by means of rare substances, and alchemy grew up; and as time passed the manipulations were extended to common things and the ban of secrecy was gradually broken, and so Chemistry arose. These four branches of knowledge concerning the inorganic interacted with mutual benefit, and for several centuries constituted science, in contradistinction from the vast body of vague thought comprised in scholasticism and folk-lore and from the more useful body of commonplace knowledge not yet consciously organized. Still later, attention was attracted by things nearer to mankind in place and character, and first plants and afterward animals were studied systematically, and Botany and Zoology arose; but for a long time the most attractive organisms were the unusual and therefore striking, or specimens brought by travelers from distant lands; indeed, even during the present half century scientific museum administrators are embarassed by the tendency of the collector to neglect the common and collect the unusual in his own locality, and it is only within a generation or two that the ordinary plants and animals supplying mankind with food and clothing and other everyday commodities have been subjected to scientific research. In like manner, the science of Geology began, soon after botany and zoology, with the study of rare minerals and the ancient rocks of remote mountains; gradually the research extended to the nearer hills and valleys and the later formations, and it is only within the present generation that the soil-making deposits on which human life so largely depends have been brought under scientific examination. Last of all, the scientific research beginning

with the stars and passing to minerals and plants and animals, and through the soil on which plants and animals live, reached man himself; yet the studied observation began not so much with fellow-citizens or fellow-subjects bound to the student by ties of consanguinity and affinity as with the abject savage or half-clad barbarian of distant lands; and even to-day, and in the most enlightened nations of the earth, the pictures brought up in most minds by the term Anthropology are those of alien and inferior peoples, or of human curiosities and monstrosities exhibited in midway plaisances, if not in circuses and dime museums. Even in scientific circles—yea, among those ranked as anthropologists—there are many who habitually restrict the term to the purely animal side of Man, and and ignore that broader and nobler side which distinguishes mankind from all other things. So, whether science be viewed in general or detail, it is found that its progress is toward the ego—toward the everyday and commonplace, perhaps, yet ever toward the more important because nearer, the more useful because the commoner; and the more nearly it approaches the more clearly it is seen that science dignifies both student and object of study—that exact knowledge, with Midas touch, turns dross to gold.

2. In general, research begins with the abnormal and proceeds toward the normal. Judging from the habits of present-day barbarians among whom the tempest is studied and the zephyr ignored, the comet remembered and the planet forgotten, the pre-Chaldean astronomers based their first celestial observations on the erratic wanderers rather than the orderly travelers of the sky; and in all ages prodigies—the bizarre and ill-formed, the gigantic and dwarfish—have been the first to catch and the longest to hold attention, among casual observers and specialists alike. This tendency toward noting the abnormal, like that of regarding the rare rather than the common, is the easily besetting sin of the touring naturalist and local museum collector, the joy of the unscientific and the despair of the scientific among museum administrators. Clearly seen in geology and zoology and botany as the vestige of a primitive past, this tendency to perceive only the abnormal is still strong—indeed almost dominant—in the younger science of anthropology; to-day distorted or wounded or cachectic skulls from the ancient ossuaries of Africa or the huacals of Peru are esteemed far above normal crania of a normal people who have by normal activities aided in making civilization and ennobling the world; to-day the platycnemic tibia and perforate humerus of questionable significance are exalted above the normal members occupied in the march of progress and the conquest of lower nature; to-day there are a flourishing sub-science called criminology and a fantastic fad of extolling and magnifying degeneracy, while the upright in mind and the sound in body are relatively neglected; yet this apparently morbid taste but reflects a tendency of the human mind, and is the promise of better things when the intellect awakened by the abnormal acquires the power of appreciating the normal. Unremembered milleniums of mystical shamanism were required to produce pathology and therapeutics, and centuries of pathology were needed to produce sound physiology and etiology, and in like manner there were generations of mystical and irrational psychomancy before students were able to recognize a basis for the modern and most promising science of psychology. It smacks of the paradox to say that the beginning with the abnormal is the normal course in the making of science; yet the history of each and all of the sciences shows that observation on the abnormal has always led attention to the normal, just as observation on the remote

has ever guided attention toward the near; and it is but natural that the youngest of the sciences should yet retain vestiges of undue magnification of the abnormal.

3. In general, scientific determination proceeds from the qualitative to the quantitative. The tendency is displayed by every branch of science, and so conspicuously that it may be deemed characteristic. It is in accordance with this tendency that estimate precedes weighing and reconnaissance goes before surveying; and it is under the same tendency that scientific progress involves constantly-increasing refinement in observation and ever-growing accuracy in definition.

4. In general, scientific interpretation proceeds from the formal to the physical,* from the material or the inert or the static to the dynamic. The positions and movements of the moon and planets were determined with fair accuracy before Newton discovered that the paths of these and all other celestial bodies are fixed by gravity; when this discovery afforded the means for determining position and movement with incomparably greater accuracy. The physical and chemical effects of heat were recognized for generations, and were ascribed to the hypothetic element phlogiston or the imaginary fluid caloric long before Juole and others found it to be merely a manifestation of molecular motion; whereupon physics and chemistry were revolutionized and the forces of nature were gradually harnessed many times more effectively than before.

The ancients recognized vitality and ascribed it usually to a material something joined to the matter of the body. Some twenty-four centuries ago sagacious Heraclitus conceived life as a universal fire, and less than five centuries ago Paracelsus, and after him van Helmont, wrote of the anima mundi, or archeus, having in mind a vaguely imponderable thing akin to the so-called astral body which votaries of an oriental belief imagine themselves able to materialize out of the depths of transcendental revery; two centuries ago Hoffmann and other anatomists spoke habitually of the vital fluid as contemporary physicists of of phlogiston, and within a hundred years leading physiologists, like Hunter, thought and wrote of a 'diffused vital material;' less than a quarter-century ago Barker was deemed bold unto recklessness for undertaking to correlate vital and physical forces,* and many heads were shaken doubtfully when, in his presidential address before the American Association at Boston in 1880, the same brilliant experimentalist argued from the applications of Mosso's plethysmograph that mental force also may be weighed and measured, so that it must be regarded as inter-convertible with other forms of energy;† yet half a generation of organic chemistry and physics has established these revolutionary propositions beyond peradventure, and introduced a new era of biologic research.

The tendency toward dynamic interpretation is well shown, too, in geology. In the infancy of the science, formations and the extinction of faunas were ascribed to extra-natural cataclysms, the opening of valleys and the shaping of hills to ill-conceived or inconceivable catastrophes; with Lyell—a personal associate of scientific men now living—came the doctrine of uniformism, under which it is recognized that existing rains and rivers and silt-distributing waves are competent to produce the

*As defined by Le Conte in a notable article 'On the Structure and Origin of Mountains,' *American Journal of Science*, third series, Vol. XVI., 1878, page 107.

*'The Correlation of Vital and Physical Forces,' University Series, Number 2 (Van Nostrand), 1875.

†Proceedings of the American Association for the Advancement of Science, Volume XXIX., 1881, page 12 *et sequentia.*

land-forms and formations of the earth, provided time enough be allowed them; the present generation of geologists, beginning with Powell and including two score others, have scanned the pages of the Great Stone Book, so well laid open by Colorado and other rivers, and have learned to read earth-history from land-forms as well as formations, and have shown that at least a portion of those earth-crust movements which were sheer mystery to Lyell result from the slow transfer of rock-matter by the action of running water. As interpretation grew definite and the mystery of earth-making dissolved, the classification gradually changed from chiefly material or static to chiefly dynamic; for a time the formations were classified by the processes of accumulation; and now the foremost geologists classify earth-science primarily by the great agencies of earth-making.

In anthropology interpretation has not yet grown definite and there are nearly as many modes of interpreting as there are men to interpret, yet even in the short and complex history of this youngest of the sciences the general tendency appears; for the earlier classifications were based on bodily or somatic features, while the more advanced among current classifications rest either on collective attributes or on the activities of the human groups—*i. e.*, the older classifications indicate what men are, the newer indicate what men do. Only half a generation past was it definitively suggested that human mentality is a form of energy, but already the testimony of the plethysmograph has been corroborated in so many ways and so widely extended that most scientific students of mental phenomena assume, either explicitly or implicitly, the essentially physical character of intellectual action; and in this writing it is assumed that intellectual energy is paramount in that it is able to control other forms of energy and make conquest of nature through invention and construction, and the faculties and works of man are classified and interpreted accordingly.

So in astronomy and physics and chemistry, and equally in biology and geology, the progress of science may be measured by the ever-increasing recognition of the dynamic aspect of phenomena, of the physical forces by which the material things are moved; with the recognition of inherent energy or motion, observation progresses from the merely qualitative to the quantitative, and constantly increases in refinement; and in view of this progress in other sciences it can hardly be regarded as premature to attempt the extension of quantitative measure and dynamic interpretation to that side of anthropology which deals with the purely human attributes.

5. In general, scientific interpretation progresses from the stationary to the sequential; for the idea of action engenders the idea of succession. The Chaldean shepherd, the Egyptian soothsayer and the Peruvian priest, like the earlier oriental astrologer, probably first took note of the celestial bodies as striking features of the cosmos, and later observed their rhythmic procession with such care that cycles were established and eclipses and other prodigies were foretold long before the true structure of the solar system was understood. These ancient observations and interpretations must have implanted that idea of the uniformity of nature which has borne so splendid fruit during the present century; the budding notion found poetic expression in pleasing fancies of firmaments of crystal and the music of the spheres; yet it was not until the germinal idea was fertilized by the Newtonian law that the marvelous measure of celestial rhythm came to be known. Led by the planless experiments of daily toil, the mechanic—forerunner of the physicist—was the next to lay hold on the notion of uniform succession; it grew

with the centuries and spread into the neighboring domain of chemistry, where it vitalized the dynamic interpretation of chemic union and aided in producing Avogadro's law, which, according to Cooke, 'holds the same place in chemistry that the law of gravitation does in astronomy '* and forms the basis of what has justly been called the New Chemistry. This law, like all others in science, afforded a means of prevision, or of presaging the unknown in terms of the known, and thus of testing its own validity; and as test followed test the idea of orderly succession grew until, with the aid of refined observation and the guidance of special experiment, it matured in the doctrine of the persistence of motion, the keynote of modern science. Here was a vantage point from which the astronomer was enabled to study the celestial bodies, especially our own sun, not merely as masses, but as chemical and physical assemblages; and so arose the line of research sometimes called celestial physics, but defined and dignified by Langley as the New Astronomy,† which has already afforded a means of analyzing the constituents and measuring the movements of several among the myriads of other suns than ours. True, each of these strides in the advance of physical science represents progressive appreciation of cosmical forces; yet still more fully do they represent progress in recognizing orderly sequence and causal succession in the movements of molar and molecular bodies.

Borrowing from physical science trenchant ideas concerning force and succession, even the earlier biologists analyzed the mechanism of living things and slowly stripped away the primitive panoply of mystery or divinity in which the infantile imagination, whether of men or races, has always enveiled vitality. Lamarck was one of the first to extend the idea of orderly succession to organisms, and, although his special hypothesis of development has fallen into abeyance, it has features which anthropologists do well to remember; then came patient Darwin and doughty Huxley and studious Spencer with the definite doctrine of organic evolution, which spread from man to man and from land to land, producing the greatest and quickest intellectual revolution in the history of the world. Albeit revolutionary, the Darwinian doctrine was but the biotic complement of the physical doctrine of the persistence of motion, and the two doctrines are twin buttresses on which the symmetric structure of modern science is supported. Through the latter doctrine the world and the things thereof were transfigured in a new beauty and perfection, the universe was invested with a new glory, and the narrow notion of breaks in the uniform course of nature by special fiat lost hold on the scientific mind forever.

It chanced that while the ferment of evolution was still fresh a trio of American geologists (Powell, followed by Gilbert and Dutton) entered the inspiring region traversed by Colorado Canyon, and before their work was done the germ of geomorphy, or the New Geology, was planted. It was realized more clearly than ever before that the hills are not everlasting but everchanging, and that the features of every landscape tell an eloquent tale of continental evolution in which competent cause and commensurate effect follow ever in ceaseless succession through the eons of earth-making. The task of the geologist is not ended, indeed is only well begun; yet here as in other sciences the reign of law is realized, and the day of appeal to chance is past.

When Huxley sought 'Man's Place in Nature,'* and still more when Darwin

* 'The New Chemistry' (International Scientific Series, VI.), 1875, page 13.

† 'The New Astronomy,' 1888, chapter 1.

* First publication in 1863.

traced 'The Descent of Man,'* the fruitful idea of the uniformity of nature was pushed into the domain of anthropology, and has now guided for a generation those branches of the science which deal with the animal side of Man; it is true that the rhythmic sequence of cause and effect has hardly been extended so far as to cover the delicate and elusive attribute of humanity, but this extension is the motive of many investigators, the aim of the present writing. Already the broad realm of humanity is fairly defined, and the distinctive form of developmental succession proper to this realm is fairly outlined, so that the distinctness of the science of human attributes has been made clear; for while stellar and molecular and organic development are evolutionary in that the main tendency of change is toward differentiation, the development of humanity is involuntary in that the main tendencies are toward integration and combination. Conformably to the fundamental facts of the great realms of nature the earlier sciences are largely, perhaps chiefly, analytic, while the science of humanity is largely, perhaps chiefly, synthetic; and its votaries seem to find reason for figuring it as the central dome crowning and conjoining the separate columns in the ideal pantheon of science. If the confidence of the votaries is just, the youngest of the sciences may be expected to repay with interest all that it received from the several branches of knowledge whence it sprang; already, indeed, it has thrown light on the course of organic development through researches on the human body, and has begun to guide the acquisition of knowledge through researches on the human brain and its functions; already it is contributing to the physical sciences, *e. g.*, through the refreshing Powellian doctrine of conservation, or of common persistence of motion and matter in the ultimate particle, whereby ideas concerning the mechanism of the universe would seem to be immeasurably simplified and extended; and there are other ways in which the youngest science is daily contributing to the stock of definite knowledge; their name is legion.

* The first edition of this notable work appeared in 1871.

So it is that science has always progressed from the rare to the common, from the remote to the near, from the abnormal to the normal, from the merely qualitative to the quantitative, from the merely material aspect to the physical aspect, from the primitive faith in fixity to living realization of causal succession. At first sight this progress may seem puzzling, even paradoxical; yet the general course is but an expression of the order of intellectual operations pursued in scientific research. The first step is observation, which is easy when the objects observed are isolated or distinct, increasingly difficult as the objects increase in number and similarity; the second step is generalization, which is relatively easy when the objects examined are few, relatively difficult when they are many; while the ancillary process of discrimination of the incongruous likewise grows laborious with the multiplication of objects and similarities. Accordingly it is easy to study the rare, the remote and the abnormal, and as faculty is strengthened by exercise, it gradually becomes easy to progress toward the common, the near and the normal. So, also, qualitative determination is easy, quantitative determination difficult; indeed, exact quantitative work is impossible without careful training, as numberless surveyors and teachers can testify. In like manner, interpretation in terms of the material, coupled with appeal to the supernatural when obstacles are encountered, is relatively easy and characteristic of the indolent or immature mind, while the firm grasp of

analogy and homology, and the clear recognition of energy and sequence, require both native capacity and systematic training. Accordingly, scientific interpretation in terms of action and succession is the end of mental effort and may be regarded as the highest expression of intellectuality. This correspondence between the method of research and the history of science throughout the centuries amply attests the excellence of the method. Yet it is not to be forgotten that just as intellectual grasp strengthens, so interpretation is simplified, partly through the elimination of that question-begging mysticism which pervades all primitive philosophies, partly through clearer arrangement of facts and relations; and as interpretation grows simple three especially noteworthy effects follow: (1) Each step in interpretation makes the later steps easier; (2) as the labor lightens, more energy is left for the next task, and the mind of the student pushes into new fields of study and from time to time organizes new branches of inquiry; and (3) with each extension of inquiry mental faculty is stimulated and strengthened. These tendencies are clearly indicated by the birth and growth of new sciences recorded in the history of research; beginning with the celestial bodies it has extended to mechanical bodies, vegetals, animals, the earth itself, then to the human body, individual and collective; and now it is reaching out toward the special attributes of mankind, the things nearest to human welfare and happiness.

V.

The domain of Anthropology is vast, and, partly by reason of its very magnitude, is sometimes deemed indefinite; yet in the light of the history of science in general its limits and subdivisions may easily be outlined.

History and analogy combine to show that the study of Man began with wounds and diseases and grew into surgery and medicine, which were at first thaumaturgic, but gradually became rational or scientific;* and in this way definite knowledge of the human body gradually accumulated and Anatomy and Physiology, with various ancillary sciences and sub-sciences, took form and function. Meantime the organs of the human body were compared and identified with those of beasts and birds (which were long the better known), and comparative anatomy was established; but it was not until observation and generalization were fertilized by scientific zoology that the study of structures in their functional aspect took shape in Morphology. Under the influence of humanitarian therapy and the unprecedented stimulus of the Darwinian doctrine of development the investigations of the last century, and particularly of the last quarter-century, have extended from structures to functions, and these, through the fruitful science of Embryology, to human ontogeny and phylogeny—to the individual and generic evolution of Man considered as an animate organism. Accordingly there are several branches of science which deal alike with the human organism and the various other animal and even vegetal organisms of the great vital series in which Man is usually, though not invariably, considered the culminating and crowning form. Here anthropology and biology blend; but it is convenient and desirable to distinguish that division of the Science of Man which deals with the organic features of the order Bimana, and this science or subscience is frequently called *Somatology*. Although the oldest and the simplest among the divisions of anthropologic science Soma-

*The genesis and development of surgery, and incidentally of medicine, are discussed in a memoir on 'Primitive Trephining in Peru,' Sixteenth Annual Report of the Bureau of American Ethnology, 1897, especially on pages 19 and 72.

tology comprises various special branches of knowledge commonly classed as sciences, including Pathology, Physiology, Etiology, etc., representing the specific methods and purposes of particular classes of investigation.

The early books and maps of civilized nations show that explorers and pioneers were profoundly impressed by the far-away peoples encountered in their wanderings; there are not only accounts but pictures of headless men with faces in their chests, of cyclops with single eyes set skyward, and of other impossible monstrosities in human semblance; even since zoology became fairly definite, accounts of ten-foot giants in Patagonia and three-foot pygmies in Central Africa and other lands remote or hidden have gained currency and credence. As exploration continued, the unconscionable extravagancies of vision were gradually corrected, and the explorers came to see alien races in proper form and something like proper stature; yet the interest in the stranger peoples remained unabated and led to systematic observation and record. Borrowing methods from biology, the observers or their interpreters sought to classify the men of different continents and provinces and islands by somatic characters —by stature, color of skin, color and texture of hair, color and attitude of eyes, form of feature, form and size of skull, peculiarities of long bones, etc.; and, as the researches became definite and fruitful, they were combined in a science of races called *Ethnology*. This science has much in common with biology, and is a direct outgrowth from that group of sciences pertaining to the human body combined under the term Somatology.

After centuries of unscientific and unsuccessful search for the seat of the soul through baseless deduction and blind introspection, certain thinkers began to profit by contemporary researches in anatomy and physiology; and as eye and mind were trained—even as the eye and mind of the traveler were trained not to make monstrosities out of unfamiliar races—the form and function of the nervous system were gradually recognized, and the dominance of the brain was finally established. Only within a generation or two has the brain been investigated in a scientific way and with due appreciation of the importance of that marvelous structure preformed in the articulates, potentialized throughout the long line of vertebrates, and perfected in the ultimate mammalian form of the genus Homo; yet during the present quarter-century the research has been organized in a science already cultivated in many lands and taught in most of the leading universities. The earlier promoters of this science approached the subject haltingly from the speculative or deductive side, and perhaps for this reason the science is named not so much from the organ itself as from its product, *Psychology*. This modern science is not to be confounded with certain fantastic notions sometimes foisted under the same designation which do little more than obstruct progress; the parent stock of the science was indeed speculative—as is most knowledge in the beginning—but so soon as the graft of somatology was affixed it became fruitful. It is to be noted that while Somatology is essentially biotic, and Ethnology is biotic in so far as it rests on bodily features, Psychology pushes beyond the domain of biology proper, partly in that the human brain owes its perfection of development to the essentially human attributes, partly in that the science, as commonly defined, embraces both brain and mind—both organ and product.

So there are three well-established and and widely recognized sciences whose object-matter is Man considered as an organism; by some students, especially those of past decades, they are held to constitute

the whole of anthropology; by others they are combined as physical anthropology and regarded as including only the animal side of man, but excluding nearly the whole of the essentially human side—nearly, but not quite, the whole, since the field of psychology is common ground. This is the view of several modern anthropologists, and is that held in this writing.

VI.

Passing from that portion of the domain of anthropology which deals with man as an animate genus, there is found another and still broader portion occupied by that which man does as a sentient, volitient and intelligent being; it is true that this portion of the domain is less definite than the other, yet, in the light of intellectual progress, its limits and subdivisions also may be outlined, albeit in some measure provisionally.

The early explorers who came home laden with travelers' tales sometimes brought also more tangible cargo in the form of strange wares; and so the handiwork of the world gradually came under the observation of students, and in time museums were built largely to accommodate the constantly increasing collections of primitive and alien arts. Meantime observant persons in many countries were attracted by relics of archaic culture in the form of implements, weapons, ornaments, apparel and habitations, as well as burial places sometimes containing the bones of the ancient artisans, and these, too, were collected, and museums were built to accommodate them in connection with the artificial material gathered among the living peoples of distant lands. As collectors and collections multiplied, the work was organized; and, although the initial stimulus came from observation in remote countries, the interest grew inward—as is the way of advancing knowledge—and the local research for the rare relics of past ages was the first to receive name and character as the science of Archæology. As observations multiplied, resemblances were found between the culture-products of remote times and remote places; the arts of primitive peoples were found to vary in a manner corresponding more or less closely to race, and thereby ethnic research gained new impetus and served in turn to guide research in the prehistoric. So archæology and ethnology became mutually helpful and grew apace and came to be intimately assosociated in most minds, despite the fact that the one is concerned primarily with what man is, the other with what man does; and in some circles these branches of inquiry came to be regarded as constituting the whole of anthropology.

At first the products of ancient and alien handiwork were accepted at their token value, much like the chemic elements before Avogadro, the planetary movements before Newton, our sun and others before the doctrine of the persistence of motion, the organic species before Darwin; but within a generation or two it has come to be realized that they possess an innate value as exponents of intellectual activity —as medals of human creation collectively attesting the birth and growth of discovery and invention, design and motive, and all other human faculties. Perhaps the time has not come for defining this stage in the progress of anthropology; it may be that the transition is not yet complete, or that the relations are too complex for easy grasp; yet it seems clear that when the anthropologist first saw in the implement of shell or stone an index to the mental operations of the implement-maker hardly less definite than the written page to the thought of the writer, the Science of Man rose to a higher plane with a bound comparable to those marking great epochs in the development of the other sciences.

Now, in science, each advance gives a new standpoint from which a broader view may be gained; and with the recognition of what may be called the dynamic aspect of artificial objects the way was prepared for further progress. It was soon perceived that the simplest devices are supplements to or substitutes for bodily organs—that the knife of shell or tooth or stone is a supplement to teeth and nails; that the hammer-stone multiplies the efficiency of blows, and that the missile is equivalent to an indefinite prolongation of reach; and accordingly it was realized that, in so far as he is a maker and user of implements and weapons, even the lowest savage rises above the plane of purely animal life. It was next perceived that even the simplest devices react on the organism in various ways. The substitution of the shell knife for nails and teeth diminishes the exercise and hence the vigor of these organs and removes them from the category of characters subject to development through the survival of the fittest in the strife for existence, so that in so far as he employs devices in lieu of organs the savage passes beyond the realm of organic development by natural selection; at the same time the exercise of making and using artificial devices in lieu of natural organs tends to develop distinctively intellectual or cerebral characters, so that the effect of competition in the use of devices is not only to remove Man from the realm of the biotic, but to set him on a new course in a different realm—the realm of the artificial or essentially human. As the view of the artificial continued to broaden it was perceived that while the simpler devices may appertain to individuals they are not integral parts of the individual, like the organs which they supplement, but may and do pass from hand to hand and from group to group; also that the use of a device by one person prompts others to acquire and use similar devices, which they are able to do immediately through mere exercise of individual volition (rather than slowly through generations of natural selection), so that each discovery or invention is at once the germ of a line of devices and a stimulus to intellectual power; and thus it was recognized that there is a strong communal tendency in the realm of the artificial—that the development of devices tends toward interchange and cooperation, yet ever of such sort as to augment intellectual power and elevate the human above the sub-human.

In the light of the dynamic interpretation of devices it is easy to perceive the trend of superorganic succession, or development of the artificial, and to contrast it with the course of biotic evolution. The substance or substratum of the latter is living matter; that of the former any matter, living or dead, with which man chooses to deal; the mode of this is slow elimination of the unfit and unpremeditated survival of the fit, the method of that is immediate imitation and designed improvement of the ingenious; the tendency of biotic evolution is toward organic differentiation, that of artificial development mainly toward organic persistence with endless multiplication and integration of devices; the effect of the one is individual or egoistic, that of the other communal and altruistic. With the recognition of the dynamic and successional aspects of artificial devices, anthropology gained a new significance; for to its objects-matter in the form of the human body and human races and the human brain there was added the whole series of artificial devices and the exceeding potent intellectual activities which these devices represent; and this addition is the basis of what is here styled the Science of Humanity.*

* The enlargement of the domain of Anthropology as here set forth is regarded as marking the most important epoch in the development of this science, one of the most important in the development

VII.

When artificial devices were interpreted in terms of activities a new classification of human handiwork arose. At the same time the activities themselves became objects of research, which soon passed beyond the collections and extended to the multifarious material devices in daily use among living peoples in the various stages of civilization from savagery to enlightenment; still later the research was extended to the intellectual or non-material devices which preeminently distinguish mankind, such as law and letters and learning in their numberless aspects. The study of the activities is now sufficiently advanced to indicate, at least provisionally, their relations among each other and to the merely organic processes; they may be arranged in the order of their affinity with the vital.

The primary activities of mankind are connected with more or less spontaneous sensations of pleasurable character. They arise and expand in fairly definite order; among known primitive peoples they appeal chiefly to the senses, and among more advanced peoples they appeal largely to the emotions and the purely intellectual faculties; they root in sports, games and decorations, and mature in the fine arts of painting, sculpture, the drama, poesy and music, *i. e.*, they constitute the esthetics. The artificial devices growing out of these activities go far toward filling those museums of the world devoted to archaic and ethnic material, and nearly a third part of current anthropologic literature is devoted to this class of objects and the activities which they represent. The activities and activital products form the object-matter of a broad and fruitful field of inquiry known of late as *Esthetology*.

2. Intimately connected with the primary activities, and also originating in spontaneous vital processes, though becoming dominant only by organization through exercise and volition, there are other activities tending toward the maintenance of physical welfare. From a simple beginning in occupations akin to those of the beasts, they arise and expand with each step in cultural advancement from savagery to enlightenment; at first confined to food-getting, they extend also to the making of apparel, the building of habitations, and eventually to the supply of intellectual demands, *i. e.*, they constitute the industries of common parlance. The material devices growing out of the industrial activities have enriched anthropologic museums almost equally with those growing out of esthetic activities, and probably a fourth part of the current literature of anthropology is devoted to them and the activities by which they are produced. Together they form the object-matter of a large and rich science commonly called *Technology*.

It is to be noted that the greater part of the material investigated by the archæologist pertains also to the fields of Esthetology and Technology, though these are far broader in that they extend not only to a greater variety of activital products, but to the activities themselves. It may also be noted that both esthetics and industries, originating as they do in vital processes, are primarily individual, though they become collective partly through combination with higher activities; while the higher activities of the series are primarily collective. It is noteworthy, too, that the two lower classes of essentially human activities rest on a material basis and are represented primarily by material devices, while the

of science in general. Several investigators have contributed to it; perhaps the earliest, one of the most voluminous, and certainly the most original, of these contributors is J. W. Powell, whose preliminary writings have appeared in a large number of addresses, official reports and minor papers, though his final conclusions are not yet published.

activities of higher planes rise above the material in their essential character and are only incidentally represented by material devices.

3. The activities of the third class are connected with collective relations; and, since they grow out of consanguinity or family relation, they may be said to have a biotic germ. In general, the products of these activities originate as customs which grade into regulations and later into laws, and are perpetuated in tribal, national and other institutions. The activities and their products are most intimately connected with, and indeed form the chief basis of, cultural progress. In the first culture stage, corresponding to what is commonly called savagery, the collective or social relation is based on kinship traced in the maternal line; in the stage commonly called barbarism, social relation rests on kinship traced through the paternal line, these stages forming tribal society. In the third stage the social organization passes from patriarchy, through feudalism, or an equivalent intermediate condition not yet formulated, to that stage of individual property-right in lands and goods which is commonly called civilization; and men are now passing into the stage characterized by intellectual property-right which is commonly called enlightenment, the organization in the last two stages being essentially non-consanguineal and constituting what is sometimes called national society. The several activities and activital products belonging to this class form the object-matter of a fecund science commonly called *Sociology*, though the day of final agreement concerning the definition of the term is not yet.

4. In some measure the activities of the fourth class are an outgrowth of those of the third, since, although essentially superorganic, they may be regarded as a means of establishing and maintaining relation; they comprise expression, pantomimic, oral and graphic. Like the other activities, they arise and expand in a certain order; beginning with what is somewhat incongruously called gesture-speech and with rudely articulate language, they mature in oratory and literature; and it is significant that the lines of development, so far as ascertained, run counter to those of biotic evolution in that they are almost wholly convergent instead of divergent; so that these activities pertain, in every essential respect, to the superorganic realm of humanity. The principal activities are speech and writing; the tangible products are legend and literature; but the rich and ever-growing content of these products is knowledge. The activities of expression and their products are commonly combined as the object-matter of another science frequently called *Philology*, though in this case, too, there is diversity in definition, and also in designation.

5. There remains a class of elusive and protean, yet immeasurably potent, activities which come so near the ego and are so hard to grasp and difficult to convey that it would seem almost hopeless to attempt to define them; they are the essentially intellectual activities which form the motive and burden of expression, and their products comprise beliefs, opinions, knowledge, wisdom and all other purely intellectual possessions. These activities also arise in a definite order, which is set forth incidentally in earlier paragraphs; and by most systematic thinkers they are considered to mature in science. The activities and their products are so obscure and so diverse that they have not been combined and named in the vernacular; yet they are by some students regarded as the object-matter of one of the broadest of the special sciences, *Sophiology*.*

So there are five classes of essentially human activities and activital products, each

*Sixteenth Annual Report of the Bureau of American Ethnology, 1897, page xviii.

so rich in phenomena and principles and so far distinct from all other classes of things as to constitute an adequate basis for a science; they are the fine arts, or esthetics, giving basis for Esthetology; industries, forming the object-matter of Technology; organizations or institutions, affording foundation for Sociology; language and literature with their science of Philology; and the great plasma of knowledge, forming the ill-defined but all-important object-matter of Sophiology. The five fields of research pertain primarily to Man and thus represent Anthropology; yet even casual survey of their extent and character renders it evident that they pertain not at all to the animal side of Man, but wholly to that side which intellectual Man alone possesses; they are five sciences of Humanity. Partly to distinguish them from the three distinct branches of knowledge concerning animal man, partly to fix their place in the body of knowledge, they have recently been combined under the term *Demonomy*;* and this system of organized knowledge concerning wholly human things may fitly be designated the greater Science of Humanity.

VIII.

As knowledge arises it is applied to the promotion of happiness and welfare; this has been true of unorganized and unconsciously organized knowledge throughout the history of mankind, and is especially true of definitely organized knowledge which thereby becomes applied science. Now knowledge concerning the human activities, even while unconscious or half conscious only, reacts upon and shapes the activities in such manner as constantly to increase their potency. Some of the ways in which the science of humanity stimulates and strengthens human activities are especially noteworthy.

* Fifteenth Annual Report of the Bureau of Ethnology, 1897, page xix.

1. While the great domain of Anthropology is divisible into an animal side comprising three broad sciences and a human side made up of five still broader fields of research, other classifications are possible, and indeed of special utility when directed toward the practical application of the science to every day affairs; for any assemblage of facts and relations may be classified in as many ways as there are purposes of classification. Experience shows that there is a peculiar advantage in classifying certain sciences by method of research rather than by the objects under investigation. Classified in this way, anthropology comprises: (1) demography, *i. e.*, the enumeration and description of men, activital products, etc.; (2) human geography (or anthropogeography), dealing with the geographic distribution of peoples and their artifacts; (3) political economy, which is concerned primarily with applied social forces and their products; (4) history, which deals with the rise and fall of peoples and nations; (5) philosophy, which scrutinizes materials and forces and sequences, and seeks the causes of growth and decadence among human things. This classification traverses the same domain as the more general one, and serves to bring out the same facts and relations in somewhat different light, *i. e.*, it is artificial rather than natural, technical rather than logical, subjective rather than objective, directive rather than creative; in brief, it pertains to applications rather than original research. For certain purposes it is desirable to combine the classifications and define special fields of inquiry by the coincidence between the two, as has recently been done happily by Giddings* and others; for the lines of thought represented in the two systems are strengthened by interaction; the one represents science, while the other may stand for statecraft or

* 'The Principles of Sociology,' 1896, page 49.

learning, and the two combine to advance mankind in knowledge and power.

2. At the outset the science of ethnology was closely affiliated with zoology, representing indeed little more than the concentration of biologic inquiry on a single order of animate organisms; but with the recognition of human activities this science was raised to a new plane. The applications of demonomy in the classification of peoples and races are many and sweeping; already the natives of the western hemisphere are classified primarily by language and incidentally by other demotic features rather than by any or all biotic characters; already the great stages in human progress from savagery to enlightenment are seriated in terms of social organization in lieu of those of the bodily features with which the biologist is wont to deal; already the present-day ethnologist gives first thought to the arts, industries, institutions, languages and ideas of the races rather than to any or all of those individual features comprised in stature and form and color; already, indeed, the recognition of human activities and the course of human development has served to revolutionize the science of races no less completely than the older sciences were revolutionized by recognition of force and sequence; and just as the New Astronomy, the New Chemistry and the New Geology are distinguished, so it is meet to distinguish a New Ethnology as a science of artificially organized groups rather than of mere upright animals.

3. With the rise of knowledge concerning activities, it was perceived that the primary function and ultimate end of devices have always been to extend and increase human power, to enable man to control plants and subjugate animals, and to evade or utilize sun and storm, *i. e.*, to make conquest of lower nature; accordingly it was recognized that, while the human characters reflect environment measurably, as the purely biotic characters do fully, it is the essential tendency and character of man to control, rather than to be controlled by, his environment. This human power did not spring into being full-fledged—indeed, science knows no Minervan birth—but grew up slowly through the exercise and gradual strengthening of volition and the evolution of design; so primitive peoples are partially controlled by their environment, while the control diminishes with successive culture stages up to that of enlightened man who dominates by multifarious devices nearly every physical force. Examination of the successive stages in emancipation from environment brings to light many significant relations; thus it is found that when two or more primitive peoples of similar culture are subjected to similar conditions of environment their minds respond in similar ways, so that similar devices are discovered or invented; and recognition of this law of human progress has served to correct some of the most persistent misapprehensions by which anthropology, like all other sciences in their infancy, has been burdened. At the same time the recognition of progressively increasing conquest over the inorganic, and the organic merely, has served to define and dignify man's estate at the head of all nature.

4. Although certain human characters and characteristics were already under investigation, it can hardly be said that mankind in general came into the domain of scientific inquiry until the Darwinian doctrine of evolution was accepted; accordingly, anthropologists at first regarded Man as subject to the law of organic development through the survival of the fittest. Then came the recognition of activital development in contradistinction from organic development, and the pendulum of opinion swung back so far as the most modern anthropologists implicitly assumed the human

form—the form of the order Bimana, genus *Homo*, and species *sapiens*—to be fixed and final. It now appears that the pendulum swung too far; for a long series of highly significant yet but half appreciative observations indicate that, just as the human mind dominates the materials and forces of lower nature, so may it measurably control and fashion the organism in which it is embodied; already hygiene and gymnastics have improved unnumbered physiques and lengthened the days of thousands; already leading educational institutions maintain physical departments in which they undertake so to shape and strengthen the limbs and lungs and even the heart and bone of the matriculate that he may be graduated sound in body as strong in mind; yet these indications would seem only to point the way of progress, and promise still better things in human development as later generations rise.

5. The most elusive attributes of humanity are those manifested in conduct and feeling and thought; yet, paradoxically, it was these obscure products of intellectual activity that men first sought to guide and control, for in every generation, in each stage of culture from the lowest savagery to the highest enlightenment, parents have essayed to train their children, while first the tribal leaders and later the sages and statesmen have semi-consciously or in full consciousness striven ceaselessly to shape the minds of the masses. So education, or the voluntary control of individual mentality for the common good, has affected profoundly the entire course of human development, and has served ever to widen the chasm separating man from the beasts. In the earlier stages of culture, as indicated by the customs of savages still living, education was limited to the lowly esthetic and industrial activity of the prime; for the primitive thinker ascribes motive, complex feeling, and all but the simplest actions to ill-conceived extraneous potencies against which it were bootless to strive. In higher savagery and in barbarism the sphere of education extended to those features of conduct involved in the maintenance of tribal relations, and was effected partly by means of habitual appeal to the extraneous potencies which were gradually crystallized in mythic systems themselves arising in a certain order determined partly by educational practice; for in much of savagery and in all of barbarism the sources of sentiment and motive are sought outside the individual and largely beyond the realm of the real. With the birth of civilization education extended to feeling and thought, partly through appeal to ideal potencies, and there was a tendency to exalt the esthetic and neglect the industrial; and certain educational systems rose so high into the supernal or passed so far into the metaphysical as to lose sight alike of individual conduct and the sources of real knowledge. In modern enlightenment—especially in America—the methods and purposes of training are shaped by science, and, despite the struggle of the scholastics, education is becoming revolutionized. With the recognition of an actual universe knowable through sense and reason, training becomes definite in plan and useful in purpose; with the recognition of cerebral function and of the influence of exercise in developing the brain, the scientific psychologists of the present decade have gone far in erecting a new platform for pedagogy; and with the recognition of the relations among the activities and the activital products of man, the normal course of intellectual development would appear to have been made clear; for it seems manifest that just as observation begins with the simple and proceeds toward the complex, and just as activity begins with the spontaneous and passes into the volitional, so individual and collective mentality must arise in simple and perhaps

spontaneous action, to grow, through habit, into sentiment, and to mature, through unconscious or conscious thought, in definite motive. It is heterodox, perhaps in more senses than one, to affirm that motive—the noblest character of humanity—buds in spontaneous action, blossoms in subconscious habit, and attains fruition in the highest intellectual activity, whether unconscious or conscious, of which the individual or group is capable; certainly the affirmation represents complete inversion of a notion prevalent in savagery, dominant in barbarism, and gradually weakening through civilization; yet it is sustained by all that is known of the processes of acquiring knowledge, by the history of the growth of knowledge in general, and, indeed, by nearly all applied statecraft and most applied priestcraft throughout human history. The recognition of the genesis and antecedents of motive must afford a vantage point for a clearer survey of the vast field of human emotion, affection, passion, aspiration, disposition; and, at the same time, it cannot fail to give a key-note for improved education—for the still more complete control of mind.

These are but a few of the many ways* in which the great science based on human activities tends to bring order out of that vast chaos of action and thought which has so long resisted analysis and synthesis—that last citadel of the unknown.

IX.

Hitherto Humanity has been the theme of poesy and romance rather than of sober science. All men have perceived that their kind possess attributes distinguishing them from the rocks and plants and beasts of lower nature, yet for the most part these attributes were either ignored or transfigured into a dazzling halo which defied analysis none the less by reason of its subjective character; even to-day and in the most enlightened circles of the most enlightened nations there are few willing to consider, and content to consider dispassionately, the purely human attributes; but to these few the chaos of industries and ideals, of emotions and passions, of conduct and motive, and of all other things human, falls into a simple order nearly as definite as the order recognized in each of the older sciences—the order of human activities and activital products.

* One of these is the control of society itself for the common good, as shown by Ward in his masterly memoir on 'Dynamic Sociology,' which it must suffice to mention merely.

Exact knowledge began with the remote and progressed toward the near; with every stage of progress it has been a power for the conquest of natural forces and conditions, has exalted intellectual mankind above all brainless or small-brained creatures, and has made continually for human welfare and happiness; and now, that the methods and purposes of science are extending to the human body and brain, it cannot be doubted that these, like all other material things, will be controlled and reconstructed for the good and the glory of intelligent Man. This is the end of the Science of Humanity.

W J McGEE.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION F.—ZOOLOGY.

The officers of the Section were as follows:

L. O. Howard, Washington, Vice-President; C. C. Nutting, Iowa City, Ia., Secretary; F. M. Webster, Councillor.

Sectional Committee: L. O. Howard, Vice-President, 1897; C. C. Nutting, Secretary, 1897; Theodore Gill, Vice-President, 1896; D. S. Kellicott, Secretary, 1896; Charles Sedgwick Minot, Henry F. Osborn, Wm. H. Ashmead.

Member of Nominating Committee: Wm. H. Ashmead.

Committee to Nominate Officers of Section: The Vice-President and Secretary and Charles Sedgwick Minot, Theodore Gill, F. M. Webster.

The scientific papers presented were as follows:

The Spread of Land Species by the Agency of Man with special Reference to Insects. Address of Vice-President Dr. L. O. Howard. Printed in Science, Sept. 10th.

(1) *On the Relationships of the Nematognaths.* By Theodore Gill, M.D., LL.D., Professor of Zoology, Columbian University, Washington, D. C.

The Nematognaths have been considered by most ichthyologists to be most nearly related to the Ganoids or even associated with them in the same order. Their entire structure, however, indicates that they are most nearly related to the Plectospondyls, and they may even associate in the same superorder for which the name Ostariophysi of Sagenmehl may be adopted.

(1) *On a Collection of Cephalopoda from the Albatross Expedition.* By Wm. E. Hoyle, Owens College, Manchester, England.

(6) *On the Sarcostyles of the Plumularidæ.* By Professor C. C. Nutting, A.M., Iowa City, Iowa.

The morphology of the Sarcostyles has been investigated by various writers from the middle of the century to the present. They are composed of ectoderm, endoderm and, according to most writers, a solid axial rod.

A body cavity was described by one of the earliest writers and redescribed by the present writer. The Sarcostyles are undoubtedly degraded 'persons' of the hydroid colony.

The function of these structures is not well understood. It appears to be partly defensive, partly prehensile and partly offensive. The function of scavengers and digestive organs has also been ascribed to them.

(8) *Notes on the Development of Drasteria erechtea.* By Professor F. M. Webster, Wooster, Ohio.

The paper gives the results obtained from rearing larvæ from the eggs to adults, and shows the individual variation of each, both in habit and appearance, the latter being the object of the studies.

(9) *Brood XVI. of Cicada septendecim in Ohio.* By Professor F. M. Webster, Wooster, Ohio.

The paper deals with the occurrence of Brood XVI. of *Cicada septendecim* in Ohio, in 1897. The area over which it has been observed is indicated; the influence of natural enemies is discussed and the probabilities of its becoming extinguished are explained.

(10) *Notes on the Embryology of the Pig.* By Dr. Charles Sedgwick Minot, Readville, Mass.

(1) *The Hypophysis.* There is a true infundibular gland, which is homologous with the saccus vasculosus of Teleosts, and is identical in form and connections with the embryonic saccus. The duct of the gland becomes a solid stalk.

There is also a true hypophysis, which develops a vestibule and gland-tubes homologous with the same parts throughout the vertebrate series.

(2) *The Cardinal Vein.* It is a striking peculiarity of transverse sections of pig-embryos that in the region of the Wolffian body no distinct vein appears, corresponding to the cardinal vein, usually found on the dorsal side of the Wolffian body. This is due to the fact that in the pig the cardinal vein, after entering the cephalic end of Wolffian body, breaks into a multiplied sinus, in which are lodged the Wolffian tubules. Another peculiarity of the cardinal vein is that it does join the jugular to

form the transverse Ductus buvieri, but joins instead the great hepatic vein (Ductus arantii) not far from the heart.

(3) *Allantoic Villi.* The stalk of the Allantois begins to form on its cephalad side within the abdomen a series of lobulated outgrowths, which gradually increase until they occupy a relatively considerable space in the abdomen. These villi consist of a cuboidal mesothelium covering a mass of matricial or ground substance, in which are scattered a few cells of mesenchymal character. The villi are beginning their development in embryos of 14.0–17.0 mm., and are already reduced in embryo of 24.0 mm. The author has no surmise to offer as to their function. Nothing similar to them is known in other mammals.

(11) *Harvard Embryological Collection.* By DR. CHARLES SEDGWICK MINOT, Readville, Mass.

The collection consists mainly of series of sections of vertebrate embryos. It is expected ultimately to have representatives of several divisions of the Mammalia, and of the principle types of non-Mammalian vertebrates.

The work of forming the collection is going forward with the following forms :

Man	Necturus
Dog	Amia
Pig	Amiurus
Rabbit	Batrachus
Chick	Acanthias
Lacerta	Torpedo
Frog	Petromyzon
Amblystoma	Amphyoxus

The plan is to select for each form a carefully graduated series of stages, and to make of each stage three complete series of sections in three planes, the transverse, the sagittal and the frontal, or if the embryo is curved or twisted the three planes are chosen at right angles to one another. A drawing of each stage is made. A double catalogue is kept; the first, in book form, is the entry-catalogue, and records all details of preservation, cutting, staining and mounting. The series of sections are numbered according to their order of entry. The second catalogue is on cards, which are arranged first according to species, second under each species according to stage. Every series of sections has a separate entry number and a separate card. Every section is counted and the sections of every series numbered. At the present time there are about one hundred series completed.

The collection is intended primarily for investigators, and is open to all competent investigators working in the Embryological Laboratory. It is hoped that it will increase during years to come, in size and still more in usefulness. So far as known to the writer, it is the first collection of the kind to be started.

(12) *Organic Selection.* By PROFESSOR H. F. OSBORN, Columbia University, and PROFESSOR E. B. POULTON, Oxford University. Duplicate title (see No. 25).

(14) *Characters for Distinguishing the North American Species of Ceresa.* By WM. H. ASHMEAD, United States National Museum, Washington, D. C.

An explanation of the application of recently discovered morphological characters to the classification of the Homopterous genus *Ceresa.* The author points out the fact that many of the genera in the Membracidæ are merely dimorphic forms of other genera.

(23) *Reconstruction of Phenacodus primævus, the most Primitive Ungulate.* By PROFESSOR HENRY F. OSBORN, Columbia University, New York.

This paper is accompanied by the remounted skeleton of Phenacodus and a wax model executed by Charles Knight. As originally mounted in Professor Cope's laboratory, the famous skeleton of *Phenacodus pri-*

mævus conveyed a very imperfect impression of its actual form and proportions. Several serious errors were committed by the restorer, the most important of which was the implanting of two of the cervical vertebræ in the tail. The author, therefore, considered it advisable to completely remount the animal, and this has been done by Mr. Adam Herman and Mr. Martin, of the American Museum, at an expenditure of five months' time.

The animal is placed as nearly as possible in a natural position. It shows that the feet were not plantigrade, or soled upon the ground, but digitigrade, as in the Tapir. The body is characterized by the great convexity of the back, characteristic of the carnivore and of all early ungulates. A further carnivorous feature is the great development of the hind quarters and of the tail. The disproportion between the hind and the forequarters is heightened by the extremely small size of the head, containing a brain which was about the size of that of the opossum, which has been fully described by Cope.

(24) *Homologies and Nomenclature of the Elements of the Molar Teeth.* By PROFESSOR HENRY F. OSBORN, Columbia University, New York.

After a brief review of the tritubercular theory of Cope, the writer spoke of his hypothesis advanced at the American Association meeting in 1891, that the multitubercular teeth of the Multituberculata and Monotremata were also of tritubercular origin. This hypothesis seems now to be confirmed by the teeth of Gomphodontia, especially of the genus *Diadermodon*, by Professor Seeley in the Narvo Beds of South Africa, of Permian age.

The various Gomphodonts in these beds present molar teeth of more or less regular tritubercular pattern. Related to them in skull structure is Tritylodon—a typical multituberculate. This indicates that from the trituberculate Gomphodonts Tritylodon and other multituberculates may have taken their origin. The paper was discussed by Professor Minot and Dr. Gill.

(25) *Modification and Variation and the Limits of Organic Selection.* By PROFESSOR HENRY F. OSBORN, Columbia University, New York, and PROFESSOR EDWARD B. POULTON, Oxford University, England.

[An account of these papers will be published in a subsequent issue of SCIENCE.]

(26) *Geographical Distribution of the Golden Warblers.* By HARRY G. OBERHOLSER, Biological Survey, United States Department of Agriculture, Washington, D. C.

The so-called Golden Warblers form a group of some twenty-five species and subspecies in the genus Dendroica, and are distributed over almost all the Nearctic region, together with the Antillian, Colombian and Central American subregions of the Neotropical. The greatest differentiation of forms occurs in the West Indies, where the distribution of many of the species is somewhat anomalous.

(27) *Modern and Older Theories of Mimicry Illustrated by Butterflies of the Genus Hypolininas.* By PROFESSOR EDWARD B. POULTON, Oxford University, England. [To be published in SCIENCE in abstract.]

WM. H. ASHMEAD,
Press Secretary.

FIELD WORK OF THE UNITED STATES COAST AND GEODETIC SURVEY.

MOST of the reports from the field parties of the United States Coast and Geodetic Survey are now in, and it is possible to summarize the work for the fiscal year ending June 30, 1897.

The operations have been, as usual, widely distributed, and cover localities on the Atlantic, Gulf and Pacific coasts, including Alaska. Much work has also been

done in the interior. Thirty land and ten parties operating on the sea were on duty during the year. The results of the labors of the land parties were as follows:

The new topographical survey of the shores of Buzzard's Bay, Massachusetts, finished.

San Francisco Harbor and Bay, nearly finished.

The Los Angeles base line in California, connected with the existing triangulation and a scheme developed by means of which a grand scheme of trigonometrical figures may be carried northward. This base, although measured years ago, had never been adequately transferred to the triangulation.

The chronometric determination of the longitude of Unalaska and Kadiak Islands, on the Aleutian Peninsula, Alaska.

The determination of the magnetic elements (declination, dip, and horizontal intensity) in nine Western States, principally in California, Montana, North and South Dakota and Nebraska.

Precise levelling in Kansas and Mississippi.

Trigonometrical work in Maryland and Delaware, completing the last direct triangulation on the Transcontinental Arc from Cape May to San Francisco.

Measure of a base at Salt Lake City with the new Duplex base apparatus.

Topography on Long Island.

Base measures in Kansas.

Triangulation at the mouth of Chesapeake Bay.

Topography and triangulation at the mouth of the Patapsco River, and on the Chester River, Maryland.

Reconnoissance in Nebraska.

Telegraphic longitude in Massachusetts, New York, Washington and Canada.

Hydrography, topography and triangulation of Lake Pontchartrain, Louisiana.

Traverse line across the Peninsula of Florida from Fernandina to Cedar Keys to connect the Gulf and Atlantic Coast triangulation.

Continuation and completion of the oblique arc along the Appalachian Chain from Maine to Mobile.

New survey of the Pribilof Islands, Bering Sea.

Connection of longitude station at Montreal with primary triangulation in New England.

Other unimportant operations were also carried on, the above being a general summary of the greater divisions of the work.

The work of the parties operating from vessels was:

Hydrographic work on the New England coast and on the Chesapeake Bay.

Special surveys on the outer bar at Brunswick, Georgia, and Long Island Sound.

Examination of Savannah River Entrance and the mouth of Elizabeth River.

Survey of Lake Pontchartrain, Louisiana, and Brazos River, Texas.

General Hydrographic work in Alaska and in San Francisco Bay.

Special work has also been done in laying out speed trial courses for testing the battleships and torpedo boats of the navy; soundings for new positions of light vessels, current observations, etc., etc.

As will be seen, the greatest activity in the land parties has been displayed in the fields of Topography, Triangulation and Magnetism. The original scheme of primary telegraphic longitudes has now been completed and the definitive values of the standard longitudes of the United States have been deduced.

The principal work of the sea parties has been on the coast of New England, in Alaska and in San Francisco Bay.

The operations during the fiscal year just closed have been productive of important results from both commercial and strategic standpoints. The completion of the survey of Buzzard's Bay, the beginning of the work near Baltimore and the rapid progress made at San Francisco are all in the interest of national defense, while the accurate determination of the longitude of Unalaska and Kadiak Islands furnishes a check to the reckoning of all vessels bound from Sitka to the mouth of the Yukon. The new speed trial courses are valuable auxiliaries to the navy, and examinations for new positions of light vessels are necessary alike to the naval and merchant marine.

The aid given to the Seal Fishery Commissioners in the way of transportation, etc., to the Guadaloupe Islands, and the cooperation with the engineer department of the army on the Brazos River, Texas, must be reckoned as not the least important incidents of the work from a commercial and

practical point of view. The progress made in all branches of the work, although comparing favorably with the operations of previous years, has not been as apparent as usual on account of many pieces of patch work made necessary by the rapid strides in the past. The work across the peninsula of Florida from Fernandina to Cedar Keys was broken off at the beginning of the Civil War and remained untouched until last winter. It will be completed during the coming season. The Transcontinental Arc begun in 1871 has just been completed by the direct chain of triangulation from Washington to Cape May, thus cutting off the older and less reliable work by way of Delaware Bay. This work, of the highest importance in international geodesy, together with the completion of the oblique arc from Maine to Mobile, already mentioned, marks an era in American geodesy and contributes new and valuable information as to the size and shape of the earth.

P.

CURRENT NOTES ON PHYSIOGRAPHY.

THREE DRIFT SHEETS OF IOWA.

The work of Calvin on Iowan drift is continued by Bain (Iowa Geol. Survey, VI., 1896, 429–476), whose report is of much geographical interest. The Kansan drift forms the surface of rather more than the southern half of the State; it is deeply weathered, the granite boulders being badly rotted and the limestone leached out; the surface is well carved by streams and holds no lakes. The Iowan drift occupies somewhat less than the northern half of the State; it is also well dissected, but less completely than the Kansan, and sloughs remain here and there on its surface. No moraine is found along its margin; but extensive loess deposits are spread forward from it over the dissected surface of the Kansan sheet. The Wisconsin drift is well developed in a strong lobe that invades the State to a little south of its center, and thus overlaps both the older sheets. Its surface is much less dissected by valleys, and many lakes remain upon it. Its border is marked by a strong moraine, from which extensive gravel trains are prolonged down the outer valleys. The diversity of the glacial period and the considerable value of inter-glacial epochs thus find much support from the Iowan geologists.

A special discussion of erosion curves accompanies the account of the Kansan drift topography; and it is pointed out that many of the rivers of to-day, although occupying valleys carved in the drift, nevertheless follow preglacial or interglacial courses, and are therefore to be called resurrected, following McGee's use of this term.

MOUNT ST. HELENS.

Lieut. C. P. Elliott, U. S. A., gives an interesting account of Mount St. Helens (Nat. Geogr. Mag., VIII., 1897, 226–230), from which many items appropriate to its class may be gathered. The mountain stands west of the Cascade range divide, its truncated cone reaching a height of 8,608 feet. Its scopes have been dissected by ravine streams and repaired by lava streams, the latter often interfering with the escape of the former and producing lakes and swamps. The ravines have the radial course usual on dissected volcanoes. The flows of lava and volcanic sand descend from near the mountain summit, running around hills as a river passes islands, and 'filling up the country' in their course. Spirit lake, five miles northeast of the summit, occupies a valley dammed by sand, ashes and pumice, which are there very plentiful. A flow that descends five miles to the southwest of the summit first nearly fills in the depression toward Green buttes; then passing around the buttes, the lava unites and fills in between Goat mountain and a ridge northeast

of it, forming a large swamp; further on it obstructs a valley on the south, forming Lake Merrill, and finally Kalama river falls over the end of the flow. Many large springs emerge from beneath the lava flows.

MAARE OF THE EIFEL.

Halbfass presents the results of soundings and temperature observations in the eight Eifel maare (Petermann's Mitt., XLIII., 1897, 149–153; with more detail in Verh. Naturh. Vereins, Bonn, 1897). A ninth maar (Wanzenboden) is only two or three m. deep, and in part thickly occupied with reeds; the Hinkelsmaar and many other basins are now converted into dry meadows. Those which still hold water deepen from margin to center; at first gradually, then more rapidly with slopes of 20–30°, and again gently near the center. Only the Laacher See is large enough to have a well defined flat central floor. The Pulver maar is the deepest (74 m.) of all German lakes outside of the Alps. The shore lines approach a circular outline, but the Meerfelder maar is like a half moon, occupying only half of its circular basin. Much statistical statement of fact with arithmetical comparison of the different maare is given. The life-history of the lakes is not directly considered.

THE EASTERN ARCTIC SEA.

Supan gives a review of Nansen's polar expedition, from which the following notes on the eastern Arctic sea (the northern part of the 'eastern hemisphere') are taken (Petermann's Mitt., VII., 1897, 158–163). Sheets of ice occupy much of the surface, continually drifted by currents and winds; now torn apart and opening water channels, now pressed together and forming walls and ridges. The latter reach heights of nine m., and offer the greatest obstacles to sled travelling. The remnants of former ridges drift about in berg-like masses with steep walls. The drift ice here is contrasted with the much thicker pack ice west of Greenland. The winter snow began melting in June, and the firm drift ice was not revealed till the end of summer. Its color is then a dirty brown, caused chiefly by mineral dust. Fresh water pools are formed on the ice surface, surprisingly rich in microscopic organisms. The ice increased in thickness slowly through the winter to June, varied until August, and decreased to early winter. Thickening in summer is ascribed to freezing underneath of fresh water supplied by melting snow above. In early spring the ice was coldest, from —16° to —30°C. In summer it approached the melting point, and then became plastic, so that crushing took place without sound; bending frequently replaced breaking.

The discovery of the great depth of the Arctic, 3000–3900 met., where traversed by the Fram, is regarded as the most important geographical result of the expedition. Polar lands are, therefore, not to be expected. A sample of serial temperature soundings gives a surface layer 200 m. deep at —1°C.; a second layer, 660 m. thick, with mean temperature of +0°.22 C., and about 3000 m. of deep water with mean temperature of —0°.57 C. The surface layer has least salt, and the intermediate layer most. The latter is supplied from the North Atlantic, dipping beneath the Arctic surface layer because its density is determined by salinity rather than by temperature.

W. M. Davis.

Harvard University.

CURRENT NOTES ON ANTHROPOLOGY.

ARREST OF DEVELOPMENT IN HUMAN GROUPS.

On this subject Professor Schrader has a curious article in the *Revue Mensuelle* of the Paris School of Anthropology. His conclusion is that the failure to advance or the actual retrogression of peoples and societies is a question of lack of adaptation to environment. This is not new; indeed, it is

quite old. His novel proposition is that, given a better environment, the most inferior race may become superior to all others. "That which we are to-day, others may be to-morrow." He also claims that a race long resident in a given *Milieu* becomes best suited to it, and, granted equal facilities, is sure to surpass all other races there. He quotes the native population of Mexico in illustration. Conquered by Cortes, beaten into the dust by brutal European rule, it has seized the arms of its conquerors, and now is rising in its might above its ancient invaders. "Is it an illusion," he asks, "that reveals to us in the physiognomy of the Yankee the hard, bony face of the Red Skin?"

PRINCIPLES OF THE STUDY OF MYTHOLOGY.

In a recent number of the monthly journal *Nord und Sud*, Dr. Thomas Achelis has a suggestive article on the relations of mythology to ethnography. He advocates and illustrates the principle now constantly gaining ground among advanced anthropologists, that if we learn accurately the daily life of primitive peoples, understand the impressions they receive from their environment and the mental impulses they gain from language and the interchange of ideas, then psychology is prepared to explain their religious perceptions according to definite and fixed principles. Similarities or identities between remote tribes will no more call for the theory of unity of source than the mere similarity of the sound of words would justify the etymologist in adopting the same theory for its explanation.

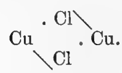
In all of his writings Dr. Achelis has pursued this same line of thought, and, although this has not recommended him to those of his reviewers who adhere to a more antiquated philosophy, there can be no question but his is the 'party of the future.'

D. G. Brinton.

University of Pennsylvania.

NOTES ON INORGANIC CHEMISTRY.

The seventh article of the series by Alfred Werner in the *Zeitschrift für anorganische Chemie*, on the constitution of inorganic compounds, describes molecular weight determinations of a large number of salts in organic solvents, such as piperidin, pyridin, methyl sulfid, etc. In the case of many salts regarding which there has been considerable doubt, the results were in accord with the monomolecular formula, as $AlCl_3$, $FeCl_3$, $FeCl_2$; also $CoCl_2$, $CoBr_2$. Tin (stannous) and lead salts were also found to be monomolecular. Cuprous salts were in general normal ($CuCl$, CuI, etc.), but showed considerable tendency to polymerize by doubling. Cuprous cyanid appeared only in dimolecular form, $Cu_2(CN)_2$. The silver halogen salts showed a strong tendency to polymerization, the iodid having a molecular weight corresponding to $(AgI)_2$, while the chlorid (and bromid) were between $(AgCl)_2$ and $(AgCl)_3$. Silver nitrate, however, had the normal formula $AgNO_3$. Professor Werner is of the opinion that in the polymerized molecule the metal atoms are not united together, but that the union is between metal and non-metal, as



It would seem possible, however, that the union might subsist through the medium of the non-metallic atoms, which would account for the greater tendency to polymerization on the part of the cyanids.

Boric acid has a quite extended use as a food preservative, but the data as to its effect on health are very meagre. R. A. Cripps, in the *Analyst* for July, recounts a series of experiments on the action of boric acid on the digestive ferments. His results are the following: With malt-extract in presence of 0.01% to 1% boric acid, starch was dissolved completely in 12 minutes, not

completely in 10 minutes. With saliva, starch was dissolved in the presence of 1% or less boric acid in from 8.5 to 11.5 minutes; with no boric acid 11.5 minutes was required. With pepsin, the digestion of egg albumen was not retarded in the presence of 1% boric acid. With zymin, milk albumen with 1% boric acid was completely peptonized in $2\frac{1}{2}$ hours. With Blumenthal's chymosin, a far larger amount of boric acid than was necessary for preservation of food did not affect the fermenting action unfavorably. While boric acid thus does not retard digestion, its physiological action still remains to be finally settled.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE 'ENCHANTED MESA' OF NEW MEXICO.

A SURVEY has just been made of the 'Enchanted Mesa,' or Mesa Encantada, of New Mexico, by a party sent out by the Bureau of American Ethnology.

This mesa was brought into prominence several years ago through the work of Bandelier, who ascertained that the neighboring Acoma Indians have a tradition that their ancestors formerly occupied the summit, but abandoned it, together with a part of the tribe, in consequence of the destruction of the pathway leading up one of its precipitous sides; the catastrophe, which was doubtless due to a cloudburst, being ascribed to supernatural agency. The same tradition was subsequently obtained by C. F. Lummis, a well-known student of the Southwestern Indians, and also (with some confirmatory evidence) by F. W. Hodge, of the ethnologic bureau. The traditional catastrophe was so magnified by repetition and so enveloped in mystery that the Indians, and after them the white settlers, had come to regard the mesa as inaccessible.

Two years ago Mr. Hodge, then studying the Acoma Indians, planned to visit the summit in order to seek for traces of the alleged occupancy in prehistoric times; but he was deterred by regard for the sentiments of the Indians, who held the eminence sacred. During the present season, Professor William Libbey, of Princeton University, after elaborate preparations, ascended the mesa, without finding (so far as the accounts published in the newspapers indicate) evidence of occupancy. Reports of this failure duly reached the neighboring Indians; they were annoyed by the suggested impeachment of their tradition, and were thereby the more easily induced to permit the ethnologic party to visit their holy place. So, on September 3d, Mr. Hodge, accompanied by Major George H. Pradt, of Laguna, New Mexico, a U. S. Deputy Surveyor; Mr. A. C. Vroman, a photogropher of Pasadena, California; Mr. H. C. Hayt, of Chicago, and two Laguna Indians, proceeded from the Indian pueblo of Acoma to the foot of the mesa, three miles distant, where they were joined by three Acoma Indians. After measuring the eminence by triangulation (the mean of two determinations is 431 feet above the plain on the west), the party at once ascended along the ancient route, and encamped on the summit for the night. During the afternoon and the next day Mr. Hodge examined the ground critically, while Major Pradt made a survey of the mesa, and Mr. Vroman secured a number of photographs. Several potsherds, two stone axes (broken), a fragment of a shell bracelet and a stone arrowpoint were the chief evidences of former occupancy found on the narrow storm-swept crest; but abundant potsherds, etc., were found in the talus swept down from the summit. All vestiges of the ancient trail ascending the talus, and continued thence to the summit by hand and foot holes in the solid rock, have been obliterated; but some traces of the holes remain. This verification of an Indian tradition notable for inherent evidence of accuracy is peculiarly gratifying to students of anthropology.

Except for the easily-removed opposition of the Acoma Indians, no difficulty was found in ascending the mesa, save for a space of a few feet at the top of the cleft; this was easily crossed on a light extension ladder carried to meet emergencies, and might have been passed with the aid of a geologic hammer to cut a few hand-holes in the steepest part of the rock.

W J M

GENERAL.

WE record with much regret the death of Mr. Theodore Lyman, the only honorary member of the National Academy of Sciences, formerly member of Congress and a distinguished officer in the army during the Civil War. Colonel Lyman was born in 1833 and died on the night of September 9th, at his summer home, at Nahant, Mass. He studied under Louis Agassiz, whose daughter he married. Colonel Lyman was a zoologist and geologist of distinction. He was the representative of a class more common in Great Britain than in the United States—a man of wealth, public spirit and wide culture, who contributed both directly and indirectly to the advancement of education, science and civilization.

THE membership of the National Academy of Science is now eighty-three. The deaths and elections to the Academy during the last six years have been as follows:

Deaths.		*Elections.*
	1891.	
Julius E. Hilgard, John Le Conte, Joseph Leidy, Miers F. Longstreth.		None.
	1892.	
T. Sterry Hunt, Joseph Lovering, J. S. Newberry, Lewis M. Rutherfurd, William P. Trowbridge, Sereno Watson.		Carl Barus, S. F. Emmons, M. Carey Lea.
	1893.	
W. H. C. Bartlett, F. A. Genth.		None.
	1894.	
Charles E. Brown-Sequard, Josiah P. Cooke.		None.
	1895.	
James D. Dana, John Newton, James E. Oliver.		W. L. Elkin, C. S. Sargent, W. H. Welch, C. O. Whitman.
	1896.	
Thomas L. Casey, G. Brown Goode, Benjamin A. Gould, H. A. Newton.		C. D. Walcott, R. S. Woodward.
	1897.	
E. D. Cope, M. Carey Lea, A. M. Mayer, J. H. Trumbull, F. A. Walker, Theodore Lyman.		E. W. Morley, C. S. Minot, W. H. Dall, F. A. Gooch.

The original act incorporating the National Academy, in 1863, limited the number of ordinary members to fifty, but this restriction was removed in 1870. A wise conservatism has regarded one hundred members as a suitable limit, but there appears to be no reason why the membership should decrease while the scientific activity of the country increases. Fifteen new members of the Royal Society are elected annually.

THE seventh annual directory of the Scientific Alliance of New York, for the year ending 1897, has been published by the Council. The number of members is 1,055, an increase of forty over last year. The membership of the several societies comprising the Alliance is as follows:

The New York Academy of Sciences, resident members and fellows,	284
Torrey Botanical Club, active members,	221
New York Microscopical Society, active members,	88
The Linnæan Society of New York, resident members,	169
The New York Mineralogical Club, total membership,	65
American Mathematical Society, local membership,	47
The New York Section of the American Chemical Society, active members,	282
The New York Entomological Society, active members,	48

ABOUT fifty members of the British Association from Great Britain, including Lord Kelvin, Lord Lister and Sir John Evans, have taken part in the extended excursion to the Pacific Coast following the Toronto meeting of the Association.

THE item, circulated by the newspapers, to the effect that four Ohio men of science had been treated with scant courtesy at the meeting of the British Association, is entirely without foundation. The complaint comes from only one of the number, a collector of fossils and a manufacturer of casts of the same, who failed to secure an announcement, concerning his specimens, in the geological section. There was, of course, no international feeling involved in the matter, The other three, professors in Cleveland and Oberlin, whose names were used

without their knowledge, repudiate any responsibility for the complaint, and say that they experienced nothing but perfect courtesy while at the Toronto meeting. Indeed, the original report contains numerous errors, for which the original complainant himself does not wish to be held responsible.

FRANZ PULSZKY, formerly director of the National Hungarian Museum and superintendent of the public museums and libraries of Hungary and a writer on archæological subjects, has died, aged 82 years. He took an important part in the attempts to establish Hungarian independence, and visited America with Kossuth, being long under sentence of death for treason against Austria.

THE Hon. Charles D. Walcott, Director of the U. S. Geological Survey, left San Francisco on September 7th, for the Yosemite Valley, accompanied by Assistant F. B. Weeks. According to a dispatch to the New York *Evening Post* he proposes to make topographical maps, on a two-mile scale, of all the forest reserves in California, which, including recent additions, comprise no less than 6,647,000 acres. On these maps the distribution of forests will be pointed out, showing the commercial and the non-commercial timber, the agricultural lands included in the forest reserves, and all settlements, roads, houses and other improvements upon the national forest domain. Since leaving Washington on July 23d Mr. Walcott has inspected the forest reserves in Wyoming, Montana, Idaho, Washington and Oregon.

THE Jackson-Harmsworth expedition duly reached London on September 3d. The results of three winters spent in scientific work in Franz Josef Land will doubtless include valuable contributions not only to Arctic geography and meteorology, but also to geology, zoology and botany.

MR. WALTER WELLMAN, the journalist and Arctic explorer, has returned to New York after a visit to Norway for the purpose of making arrangements for his proposed Arctic expedition. According to statements in the daily papers, he proposes to sail from Bergen in a staunch steamship on June 13th of next year for Franz Josef Land. He expects to establish a supply station at Cape Flora and to reach Cape Fligely before the winter sets in. Then, in 1899, he intends to try to traverse on sleds the 550 miles to the Pole.

MR. A. W. GRABAU, of Boston, is continuing the field excursions for the study of natural history begun last year and made possible by the generosity of an anonymous donor. He met applicants for membership at the Museum of Natural History on September 11th and gave an account of the course in marine zoology which will take the class to the seashore near Boston. At two o'clock the party left for Beverly. Other excursions have been arranged as follows: September 15th, Revere Beach; September 18th, Nahant; September 22d, Marblehead; September 25th, Swampscott; September 29th, Bass Point.

THE New York *Evening Post* reports that the Chabot Observatory, of Oakland, Cal., has decided to send a special expedition to India to observe the total eclipse of the sun. It will be headed by astronomer Burckhalter, whose expenses will be paid by William Pearson, of San Francisco. Dr. George C. Pardee will provide a new lens for the use of the observers. The expedition is, of course, entirely distinct from that to be sent out by the Lick Observatory, the funds for which were provided by the late Mr. Crocker.

THE Prince of Monaco, in his steam yacht, the Princess Alice, is said to have completed a season's researches in the Azores.

IN view of the outbreak of yellow fever at Ocean Springs, the Surgeon-General has instructed Dr. Wasdin to investigate the disease in accordance with Dr. Sanarelli's methods and has forwarded him the necessary outfit.

THE daily papers report Dr. H. B. Guppy, an English naturalist, returned to Napoopee, Hawaii, on September 1st, after spending twenty-three days alone on the summit of Mauna Loa, at an elevation of 13,000 feet above sea level. He carefully explored the crater of the volcano and made collections of the fauna and flora.

AN Engineers' Club has been established in Chicago, the object of which is to be the advancement of engineering in its several branches, the professional improvement of its members,

and the encouragement of social intercourse among men of practical science. It is proposed to publish proceedings, to maintain a library and a collection of drawings and models.

A NATURAL Science Association was organized in Jersey on August 5th, with Dr. A. C. Goodfrey as the first President.

THE French Society of Civil Engineers appointed some time since a committee to consider the propositions that have been made for the decimalization of time and angles. This committee has made its report adverse to the proposed reform but recommending the numbering of the hours of a day continuously up to twenty-four.

IN connection with the Brussels Exposition there was held an International Congress of Commerce and Industries from September 7th to 11th.

THE library at Massillon, Ohio, has recently received generous gifts. The residence of the late Mr. Nahum Russell, valued at $30,000, has been presented to the city by his daughters, and Mr. J. W. McClymonds has given an endowment fund of $20,000.

THE British 'blue-book,' recently issued relating to the nature and extent of the trade of Australia and adjacent colonies, contains some interesting and useful information for American manufacturers. It appears that, in New Zealand, for example, Germany and Belgium, not Great Britain, send in the greater part of the supply of firearms. Glassware comes from Belgium; saws, almost exclusively, from the United States. Axes come exclusively from the United States, and carpenters' hammers from the same source mainly, though England still furnishes the heavier and ruder sorts, such as are used by blacksmiths and machinists. Germany and Belgium supply nails, and the former is gradually encroaching upon the market for machine tools, formerly controlled by England. All the agricultural machinery is furnished by the manufacturers of the United States, who produce the most remarkable combination of lightness and strength, and yet sell at lower prices than even Continental nations can yet attain. The reasons for Great Britain's 'temporary decline' are said to be: Conservatism, lack of versatilty and adaptability, disdain of methods successfully adopted by competing vendors, stringency in calling for payment and 'a general haughtiness in trading transactions.' As one of the London trade papers says: "When a wealthy London corporation builds and equips a London railroad with American plant it is time for English manufacturers to see themselves as others see them."

IT is stated in *Machinery* that Acetylene is now in use in several of the Paris omnibuses. The generator weighs about 29 lb., and is carried under the front steps. Each load of carbide is about 0.71 lb., and produces about 3 cubic feet of gas, which is enough for 6½ hours, with a light of 16 candles. The pressure is regulated so as not to exceed 4 inches of water. The cost is less than that of petroleum. Electrical accumulators to do the same work weighed nearly 3 cwt., and did mischief, so that they were glad to give them up.

THE *Philosophical Review*, edited by President Schurman and Professors J. E. Creighton and James Seth, of Cornell University, and published since its foundation by Ginn & Co., will next year be published by The Macmillan Company.

THE Principles of Sociology, by Professor Franklin H. Giddings, of Columbia University, of which a third edition has recently been published by The Macmillan Company, has been translated into French and German, and a Spanish translation is announced for early publication.

VOLUME two of the *Maryland Geological Survey Reports*, which will contain a description of the building and decorative stones of the State, is well advanced and will be issued the coming winter.

PRESIDENT C. G. WILSON, of the New York Board of Health, has made a report showing the remarkable decrease in the death-rate of New York City since 1823. Figures for the first eight months for each of the last six years.

	Estimated Population.	Deaths, Jan. to Aug., inclusive.	Death rate.
1893.......	1,758,010	31,982	27.3
1894........	1,809,353	29,397	24.4
1895........	1,879,195	30,699	24.5
1896........	1,934,077	30,307	23.5
1897........	1,990,562	26,866	20.2

THE report of the committee of the British Council on Education on schools for the blind and deaf, for the past year, has been published as a Blue-book, signed by the Duke of Devonshire and Sir John Gorst, and is abstracted in the London *Times*. During the year ending August 31, 1896, the number of certified schools increased from 84 to 91. These schools provide accommodation for 1,476 blind children (268 day scholars and 1,208 boarders), and for 3,004 deaf children (1,699 day scholars and 1,305 boarders). The total grants paid for the year amounted to £15,629 12s. A general report by the Rev. T. W. Sharpe, Senior Chief Inspector, follows, covering the year ended March 31, 1897. He states that the year has been marked by steady progress, and pleads for higher payment of teachers, both for the blind and deaf. The hope is expressed that a recent return called for by the department will produce some result. This return requires each school authority to give the name of every blind and deaf child in its district between the ages of 5 and 16 and 7 and 16 respectively. The address of the parent or guardian and the provision made under the statute for the education of the child are also required. With regard to deaf children, Mr Sharpe states that the teaching on the oral system in some institutions is very imperfectly carried out, and that oral teaching is in danger of being discredited from the fact that, however excellent the school teaching may be, the continued practice of speech outside the schoolroom is either left to chance or so mixed with signs that it receives very little care.

UNIVERSITY AND EDUCATIONAL NEWS.

DR. ANDREWS has withdrawn his resignation from the presidency of Brown University.

WE should be glad to welcome a 'Cosmopolitan' reading circle or Correspondence School, even though its standard should be no higher than that of *The Cosmopolitan* magazine. But the projectors of the 'Cosmopolitan University' cannot make silver equal to gold by debasing a name. Fortunately, the performance is illegal in the State of New York. Section 33, Chapter 378, of the laws of the State reads as follows:

> No individual, association or corporation not holding university or college degree-conferring powers by special charter from the Legislature of the State or from the regents shall confer any degrees, or after January 1, 1893, shall transact business under or in any way assume the name university or college, till it shall have received from the regents under their seal written permission to use such name.

The minimum requirements for a degree-conferring institution have been carefully defined by the regents, and it is scarcely needful to state that these cannot be met by an annex to a magazine.

AN editorial in the last number of the *Educational Review* on the Brown University incident concludes with the moral: "What a comment this occurrence is on the project for a national university at Washington, that is still kept alive by earnest but, we believe, misguided men!" The article was written on the assumption that "Rhode Island and Providence will not support an educational institution in which an officer of prominence holds views antagonistic to their own on an economic question that is under present discussion." The frank and wise declaration of the corporation of Brown University for academic freedom, even under aggravating circumstances, shows that the *Educational Review* is needlessly pessimistic in its point of view. It would, indeed, be better to have a struggle for academic freedom in a national university and lose than not to have the university and the struggle. The effect on other universities and on the education of the people would be beneficial, and the defeat would be but temporary. Neither pedagogy nor politics is at present a science, and they only come within the scope of this JOURNAL in so far as they concern the advancement of science. But an affiliation of the national scientific institutions at Washington, with power to grant degrees for research, would be the basis for a university in which science and investigation would have the place now held at Oxford, *e. g.*, bythe classics and information. It is a scientific experiment that all men of science should advocate.

THE *Educational Review*, however, appears to

be also pessimistic regarding those whom it calls 'natural scientists,' for the editorial quoted above says: "Devotees of natural science are, as a rule, the most intolerant of all university teachers, especially toward differences of opinion within their own sphere." We have published a number of articles on scientific education, but none of these have betrayed a prejudice against the classics equal to that against modern scientific education shown recently by Professor Wilson, of Princeton; Professor Peck, of Columbia, and President Stryker, of Hamilton, nor equal to that against the classics in the recent program of President Andrews, himself formerly a teacher of classics.

WHILE engaged in promulgation we may remark that President Stryker, who had much to say last winter in regard to 'debasing' the A. B. degree by granting it for scientific studies, has allowed Hamilton College to give the degree of Ph. D. *causa honoris*. This, we believe, is illegal in the State of New York.

THE will of Charles T. Wilder, of Wellesley, Mass., gives more than $100,000 to charitable and educational institutions, including $10,000 each to Robert College at Constantinople, the Armenian School for Girls at Constantinople, the Colorado College at Colorado Springs, Whitman College at Walla Walla, Wash., and Charleston College, Northfield, Mass. In a codicil dated July 27, 1897, Mr. Wilder bequeathed $15,000 to the trustees of Amherst College for the purchase of land for an observatory. The residue of the estate, both real and personal, is left to the executors in trust to be distributed among charitable, educational and religious institutions.

THERE is offered this year at Amherst College a prize of $500 for the best prepared freshman in the classical division and a similar prize of $300 in the scientific division.

THREE new associate professors have been appointed at Oberlin College, Charles Edward St. John, Ph.D. (Harvard), in physics and mathematics; Herbert Lyon Jones, M.S. (Denison), A.M. (Harvard), in Botany, and S. F. McLennan, A.B. (Toronto), and Ph.D. (Chicago), in psychology and pedagogy.

AT Williams College, Mr. Edward V. Huntingdon (Harvard) has been appointed instructor in mathematics and Mr. Frank H. Williams, assistant in chemistry.

DISCUSSION AND CORRESPONDENCE.

AMPHIBIA OR BATRACHIA.

As Professor Wilder * has expressed the hope that the discussion on the proper name of the class variously known as Amphibia or Batrachia 'may continue until all doubts are removed,' I venture to add my contribution. Dr. Baur † has treated the history of the nomenclature in his usual thorough manner, but perhaps has not laid sufficient emphasis on one point (although fully recognizing it himself), which has influenced me more than any others and probably will appeal to Professor Wilder more than the others.

The principle of priority of nomenclature should guide us in the selection of names of large groups as well as those of genera and species, provided there is no counteracting element or objection. It is especially important to retain the names of Linnæus as much as possible.

Linnæus introduced into the system six classes—Mammalia, Aves, Amphibia, Pisces, Insecta and Vermes. These have all been generally retained by succeeding naturalists except Amphibia. While many have adopted Amphibia, however, still more, perhaps, have employed Batrachia. But there appears to be no good reason for this use of Batrachia at the expense of Amphibia.

Amphibia should be retained as a *class* name, as it was at first given *as such*, and the fact that the class as originally constituted contained diverse elements should weigh no more against the adoption than the analogous extensions in the case of *Insecta* and *Vermes* or innumerable genera. The name should be restricted to the typical subdivision of the primitive Amphibia.

The name Amphibia, doubtless, expresses the concept of Linnæus derived from his own observations of living animals, and he must have been most impressed with the metamorphosis of some which he mentions first among

* SCIENCE, August 20, 1897, p. 295.

† SCIENCE, July 30, 1897, pp. 170–174.

biological attributes of the class ('aliis metamorphosin subire'). But however this may be, the name was first limited to the forms undergoing metamorphosis by De Blainville, and there is no reason why that restriction should not be respected.

The name Batraciens, or Batrachia, was given as an *ordinal* name. It was not used as a class name till long after Amphibia had been duly restricted to the class still so called.

If the name Batrachia were usable at all it should only be as an ordinal designation, as Huxley has done. But it cannot be legitimately used as such, because many years before the name Salientia had been introduced by Laurenti for the same order, and most of the best herpetologists of the present time (Cope, Boulenger, et al.), have revived or accept the name for the order so designated.

The name Amphibia was first used as a class name by Linnæus for a group which was certainly very heterogeneous, inasmuch as it included not only the typical Amphibians and reptiles, but also the Marsipobranchs and Selachians, as well as certain true fishes (Lophius, Acipenser, etc.). The class was divested of the fish-like forms by the editor of the Systema Naturæ (Gmelin, 1788), and with these limits it was long retained.

The essential point in the case under consideration is that Linnæus first recognized a *class* intermediate between fishes and birds, whose *typical* representatives pass part of their life in water and part on land, and the apt name Amphibia was given to that class. (The name is eminently suggestive and expressive for the class as now limited.) Batrachia was given long afterwards both as an ordinal and class designation. (The name is quite inapt for many of the species.)

THEO. GILL.

SURVIVAL OF THE ART OF ILLUMINATING MANUSCRIPTS AMONG THE GERMANS IN EASTERN PENNSYLVANIA.

AMONG the interesting objects included in the collection of tools, utensils and paraphernalia, representing the life of the American pioneer, recently made for the Historical Society of Bucks County, Pennsylvania, two curious paint boxes, for a time defying explanation, have at last led to an interesting observation. By degrees, after a series of investigations, beginning on August 20th, I learned that these boxes had contained, in their wooden compartments, the paints and colored inks by which the masters of the German schools in upper Bucks County (discontinued about 1850), taught the art of *Fractur*, or illuminative handwriting done in colors for permanent preservation. The liquid colors mixed in whiskey were contained in the little glass bottles still occupying their pigeon holes in one of the boxes. Other bottles contained inks, and one the varnish, consisting of the gum of the cherry tree diluted in water. A long compartment held the brushes and quill pens.

With these implements the masters of *Fractur*, generally Mennonites (who sometimes instructed pupils in the art as an addition to the ordinary tuition of a schoolmaster), illuminated the title pages of numerous Mennonite manuscript song books still extant in the county, produced elaborate title pages for Bibles, name cards, marriage and death registers, and Scriptural texts. A striking example in the possession of Henry K. Gross, of Doylestown, is a transcription of the 18th verse of the 19th chapter of John with decorated letters and floriated capitals in red, green, brown, blue and black, set above a bar of music, and twelve lines of cursive manuscript, upon which are placed two birds in red, green and black. A pious admonition in red and black text edges transversely the left end, while the lower margin is filled with an alphabet in various text. The borders are floriated and plain red or blue.

Further examples are: A, Title page to Church song book (*Lieder Buch*, printed in Germantown, by Michael Villmeyer, in 1811), name Susanna Fretz upon heart, from which springs a tree with conventional tulips; deep beaded borderings, 1814, colors red, brown, yellow and black, red predominant. B, Title page to manuscript song book, name Susanna Fretz (spelled Fretzin for feminine) in red circle with date 1810; stalks with black leaves and conventional tulips to right and left; foliated border with red leaves on black and yellow ground. C, Title page to manuscript hymnbook; name,

Joseph Gross, illuminated letters, foliated capitals; date, April 20, 1830; double tulips in foliate on yellow ground. D, Title page to manuscript hymn book, name Sarah Wismer; foliated capitals, conventional flowers on heavy stalks; date 1827; colors red, yellow, brown and blue. E, Title page to ditto; name, Elizabeth Nesch (Neschin), with words Dieses Sing-Noten Buchlein Gehoret Mir; Sing Schuler In Der Bedminster Schule; Geschrieben September 6—ten im Jahr 1799, with three tulips and several colors. Other examples are within easy reach of the writer. And it has appeared evident that the art thus preserved by Mennonites in a remote part of Bucks County until about 1850, and represented by the old paint boxes in possession of the Historical Society, is a survival in America of the mediæval art of manuscript illumination. Much more remains to be said upon this subject which reveals the early relation of Germany to the United States in one of its most interesting aspects.

HENRY C. MERCER.

INDIAN HOUSE, August 30, 1897.

REMARKABLE HAILSTONES.

ABOUT 5 o'clock in the afternoon of August 10th I was at Manassas depot, in Prince William County, Va., near the famous battlefield, waiting for a train. There was some pretty severe thunder and lightning for a half hour or so, and then came a heavy shower of rain, during which there was the most remarkable fall of hail I have ever witnessed. I hurried out in the rain to examine the stones and picked up several. These were nearly square flattish blocks, say from $\frac{3}{4}$ to 1 inch in length and breadth, and from $\frac{1}{4}$ to $\frac{1}{2}$ an inch in thickness. They suggested, by both shape and size, the ordinary 'chocolate caramels,' of the confectioner. There were some 8 or 10 persons, I think, in the station house with me, and several of these, observing my interest and enthusiasm, began to pick up the larger stones and bring them in to me and to to my friend, Professor Hargrove, of Luray, Va. Soon larger and larger ones were thus collected, and I sought for means of measuring or weighing them. No rule or scales could be found, and

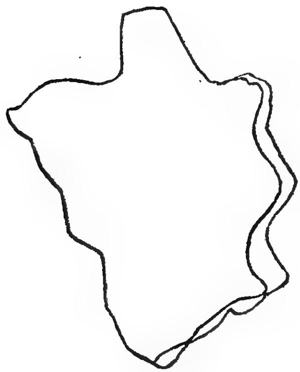


FIG. 1.

FIG. 2.

Outline of Hailstones that fell at Manassas, Va., August 10, 1897.

so we set ourselves, several of us, conjointly and carefully to estimate the dimensions. I recorded at the time one as being, honestly estimated, '2 inches long, $1\frac{1}{2}$ inches wide and $\frac{3}{4}$ of an inch thick,' these being rather the average than the extreme dimensions.

It then occurred to me to make an outline drawing of the largest by laying it flat upon a page of my pocket memorandum and carefully running a pencil around it. I secured, in this way, a rather rough but fairly accurate outline of two. These outlines have been exactly copied (including some lines due to a slipping of the block or to a different inclination of the pencil) and are given in the accompanying cuts. The extreme lengths of these will be found to be, respectively, about $2\frac{1}{2}$ and 3 inches; their extreme breadths about $1\frac{1}{2}$ and 2 inches. The thickness of No. 1 was recorded at the time as being by estimate $\frac{3}{4}$ inch; that of No. 2 as being one inch. I estimate their volumes as about $1\frac{3}{4}$ cubic inches for No. 1 and nearly 3 cubic inches for No. 2. The drawing of No. 2 was done more hastily, as just in the midst of it my train rushed in and I had to leave. But I took my trophy with me, and, with perhaps pardonable enthusiasm, paraded it through the cars, and, exhibiting it to the passengers, asked expressions of opinions from them as to its size relatively to that of a popular object of comparison, a guinea egg. Perhaps 20 or 30 passengers agreed, without dissent, that it was as large or larger. Some said, 'It is as large as a hen's egg;' all agreed, also, that they had never seen so large a hailstone before. Upon breaking it to pieces, I found a sort of nucleus, of somewhat less transparent ice at the center, but observed no concentric layers or other marked structure of any kind; it was quite solid and tolerably transparent throughout. Both of these stones were characterized by blunt points or projections, as shown in the figures; and the sides also, while flat in the main, were uneven with low, rounded elevations and depressions of the same sort, the general thickness being fairly uniform.

I think that very few of these stones or blocks fell. Perhaps they would have been a yard or two apart as they lay on the ground. I think it likely also that the storm of hail was of brief duration, say 10 or 15 minutes, and that it embraced a very limited area.

It was, perhaps, about over when I took the train, as I infer from the fact that I have seen no account of it in the papers; and I found at the next station, only 5 miles off, that the road was dry and dusty.

I regret exceedingly that no more accurate observations seem to have been made of what must have been a most notable hailstorm, and I diffidently submit my own crude and imperfect account in the hope that thereby something further may be elicited in regard to it.

CHAS. H. WINSTON.

RICHMOND COLLEGE, VA.,
August 25, 1897.

THE DEATH OF VICTOR MEYER.

MANY years will pass before Heidelberg entirely recovers from the shock produced by the recent sudden death of Victor Meyer. That so great a man should depart in such a way, and in the prime of his life, seems to be the regret of all who knew his accomplishments.

The work of the semester was practically at an end and the majority of the students had left for the long vacation. It had been a very busy and fruitful period for the department. Every desk had been taken and many applicants turned away. Each student seemed proud of the privilege to work under such distinguished professors, chief among whom was Victor Meyer. His masterly leadership, scholarly attainments and genial manner were the constant inspiration of every one. On the 5th of August he had drawn to a close his annual course of lectures on experimental chemistry. After lingering for a moment to discuss the composition and decay of organic matter, and thanking his listeners for their faithfulness, he left the hall amid deafening and prolonged applause.

Returning from a social gathering rather late Saturday evening, he retired to his room, with the request that he be not disturbed on the following morning. When the door was forced open at noon by the anxious family he had already been dead some time, and the cyanide bottle by the bedside told the story.

When it was first reported that the beloved teacher had died by his own hand, not even his

most intimate friends would believe it, and to many the matter is still an enigma. He seemed too great a philosopher to countenance such an act. It is not improbable that temporary insanity shattered his mind. No expert opinion has been published. Although the fact was seldom noticeable, the great chemist was a very nervous man and had for an extended period been under medical treatment, but without great avail. During the previous winter he was forced to reduce the number of his lectures, but he persisted to the last in assuming all the responsibilities that fall upon a director of so large an institution. The strain was too great. For the last four days he was unable to sleep at all, and the man whose face was still as quiet and pleasant as ever was probably distracted by the fear that the physical forces which had served him so well were threatened with destruction. Only those who have suffered as he did can rightly judge the man. Certain it is that the annoying rumors, circulated by irresponsible reporters, are without any foundation. Of the two letters found on his desk, one expressed his love for his family in most endearing terms. The other was a farewell to his close friend, Kuehne, the famous physiologist.

On account of his expressed wish and because the semester had closed, elaborate ceremonies were avoided. As the quiet assemblage, including many famous scholars, stood around the grave, wreath after wreath was laid at its head. The venerable Bunsen, to whom Victor Meyer went at the age of sixteen to learn chemistry, sent a laurel from his home near by. Adolph von Baeyer came from Munich with a wreath 'to his best friend.' The German Chemical Society paid a tribute to its lost President, and the grand-ducal family of Baden sent a token. Among the many other wreaths was one bearing the words, 'Dem grossen Lehrer in Dankbarkeit, Seine Amerikanischen Schüler.' Heidelberg suffers a great loss, not only as a university, but as a city, for Victor Meyer was a citizen, as well as a scientist, and, while he was profoundly versed in every department of chemistry, he found time to encourage the development of the fine arts.

It is fortunate that there remain such splendid representatives of his school as those who have been his assistant professors. The vacant chair may not be filled for some months. Temporarily the direction of the laboratory is in the hands of Professor Gattermann, who is pushing so rapidly to the front of his science. The other professors, Jannasch, Auwers, Goldschmidt and Knoevenagel are all well-known investigators, and have their own large circles of admiring students.

H. C. COOPER.

HEIDELBERG, August 15, 1897.

THE ANTHROPOLOGICAL SESSION AT TORONTO.

IT may be worth a few lines in SCIENCE to say a word in correction of the many erroneous and even ludicrous newspaper reports of the above meeting which suggest to the memory the famous definition of the crab by the French Academy before it was criticised by Cuvier.

The paleolithic or neolithic age of the New London stone axe was not a subject of discussion, as reported, simply because there was no room for two opinions on the matter. It is beyond all question neolithic, as every archæologist would be ready to assert at a glance.

Nor was any attempt made to prove that American man was older than European man, because again the evidence is so far absolutely conclusive on the other side. The paleoliths of Europe antedate all relics yet known from this continent.

Nor, thirdly, was any attempt made to prove the existence of preglacial man in America. The speakers who claimed the greatest antiquity advocated nothing more than a late glacial date for the oldest traces of human handiwork in this country.

As these three points formed the chief part of many of the reports of the meeting, it is easy to see how far short they fell of correctly representing the speakers.

E. W. CLAYPOLE.

SCIENTIFIC LITERATURE.

THE GENESIS OF THE DIAMOND.

THERE has recently been published a volume of small size, but of especial interest and importance, in regard to the origin of diamonds.

This is none other than the posthumous issue of the full papers of the late Professor H. Car-

vill Lewis, edited by his friend, Professor T. G. Bonney, of London.*

It will be remembered that Professor Lewis was the first to present a clear and definite theory of the origin of the South African diamonds, as resulting from the intrusion of igneous rocks into and through carbonaceous shales, and the crystallization of the carbon throughout the rock as it cooled, from hydrocarbons distilled from the shale that had been broken through. These views, now for the most part accepted, and subsequently confirmed by other and very interesting parallel discoveries, he presented in two papers read before the British Association for the Advancement of Science at its meetings held in 1886, at Birmingham, and in 1887, at Manchester. Before he was able, however, to prepare them for publication and carry them to the greater completeness that he desired, Professor Lewis succumbed to an attack of typhoid fever, which removed one of the most brilliant and capable of the rising scientists of this country. Agreeably to his expressed wishes, his material was entrusted to his friend and co-laborer, Professor George H. Williams, of Johns Hopkins University; but, by a strange fatality, before the latter had time to arrange and edit these papers this distinguished scientist also fell a victim to the same disease, in 1894. The work was then committed to Professor Bonney and is at last given to the scientific world.

The book consists of an introductory note by Mrs. Lewis; a preface by Professor Bonney; the two papers of Professor Lewis himself, with some later notices and references by the editor; a brief account of similar material from other localities, belonging to Professor Lewis—also by the editor; a closing note on some other MSS. of Professor Lewis, and a full index. There are also two plates and a number of smaller illustrations, the latter from Professor Lewis' own drawings.

*Papers and notes on the 'Genesis and Matrix of the Diamond.' By the late Henry Carvill Lewis, M.A., F.G.S., Professor of Mineralogy in the Academy of Natural Sciences, Philadelphia, Professor of Geology in Haverford College, U. S. A. Pages xvi+72. 2 Plates. Edited from his unpublished MSS., by Professor T. G. Bonney, D.Sc. LL.D., F.R.S., &c. Longmans, Green & Co., London and Bombay. 1897.

The first paper, 'On a diamond-bearing peridotite and on the history of the diamond' (1886), is brief, dealing with the general character and occurrence of the diamantiferous rock at Kimberley, and outlining Professor Lewis' theory.

The second paper, 'The matrix of the diamond' (1887), is more extended and goes into an exhaustive discussion and comparison of the various aspects, contents and alterations of the rock, which he finds to be different from any previously described, and, therefore, proposes for it the name of Kimberlite. Its main character is that of a highly basic porphyritic peridotite, filled with olivine crystals and grains, more or less altered, and various other minerals—serpentine, tremolite, etc., with bronzite, rutile, perovskite, pyrope garnets, micaceous minerals and other forms, and at times brecciated in structure, filled with fragments of carbonaceous shale brought up from below. The shales are of Triassic age, the 'Karoo beds' of that region, and the intrusion of the peridotite in the great 'pipes' or chimneys that constitute the mines is therefore proved to be of a later, though not exactly determined period.

The question has sometimes been raised whether the diamonds themselves may not have been carried up from a deeper source in rocks below, instead of originating in the peridotite; and the occurrence of broken crystals has been cited in support of this view. Professor Lewis, however, disposes very completely of this idea in two ways: He refers to the well-known fact that each of the great mines or 'pipes' yields diamonds that have, in some respects, a type of character peculiar to that one and different from the others, so that African experts, and even those who have never been there, can recognize from which mine any diamond has come. Further, as to the broken crystals, he shows that breakage not unfrequently occurs after the diamonds are removed from the rock, and points out that this is a result of strain in their formation, as indicated by microscopical and optical examination, and that such a condition is known to produce ruptures and explosions in other minerals. It may be added here, although Professor Lewis does not speak of it, that many crystals must be broken in the blasting of the rock, the shoveling and the carting

of the loosened material, and the various mechanical processes employed at the mines, and that pieces of such broken crystals would be separated and scattered to various parts of the immense dumping and weathering floors, never to be recognized as fragments of the same one when finally recovered, perhaps at very different times.

The rock itself is a dark green, compact material, resembling serpentine and containing a large proportion of olivine, in grains and crystals; several green minerals that are not conspicuous, from the resemblance of their color to the ground-mass (enstatite, chrome-diopside, smaragdite and bastite); a mica, probably biotite, more conspicuous and quite abundant, and frequent grains of pyrope garnet, sometimes of gem quality and great beauty, and miscalled 'Cape Rubies.' Of smaller disseminated minerals are to be noted perovskite, quite frequent, and magnetite, chromite, ilmenite and picotite, less so, though common. Rare and minute occurrences are apatite, epidote, orthite, tremolite, tourmaline, rutile, sphene, leucoxene. As decomposition products there are serpentine and calcite, abundant, and zeolites, chalcedony and talc; also cyanite (?) These, with diamonds and included fragments of carbonaceous shale, make up the contents of this remarkable rock.

Professor Lewis then goes into a detailed account of the mode of occurrence of these minerals, beginning with the most conspicuous species—the olivine—which is remarkable for its fine cleavage-surfaces and very interesting in its alterations. These are chiefly (1) into serpentine, proceeding from without inward, and penetrating along crevices and fractures, also sometimes in the form of chrysotile, producing a velvety border or coating to the grain; (2) tremolite, more internal, the fibrous structure developing parallel to the vertical axis and domes of the olivine crystals; (3) when both these alterations are present and have gone so far as to obliterate most or all of the olivine, a talc-like substance intervenes between them in which are developed minute needles of rutile, arranged parallel to the faces of the olivine crystal. The rock contains every stage of these changes from pure bright unaltered olivine to those forms that have borders of serpentine or chrysotile, or incipient tremolite fibers within, to the complete alteration just described. The relation of all these to similar phenomena in other rocks, and in meteorites, is discussed with much fulness.

Professor Lewis then takes up the smaragdite, chrome-diopside, bastite and enstatite (or bronzite, for it is just on the line between the two varieties). The two first named are, in some cases, fine enough in color and clearness to yield gems, and also sometimes the bronzite; all are colored by chromium. The diopside occasionally gives rise to calcite by alteration.

The mica is next considered; as all who are familiar with the rock are aware, it is the most prominent of the contained minerals to the eye. It is somewhat anomalous in character, being chemically a biotite, but optically nearer to phlogopite. It occurs in several distinct ways: (1) as included crystalline masses or plates, apparently an original ingredient of the rock; (2) surrounding grains of pyrope; (3) rarely, as a result of the alteration of enstatite; and (4) as a metamorphic product from the included fragments of shale; and the first form has produced, by hydration, the vermiculite variety called vaalite, which occurs freely in the decomposed peridotite so largely known as the 'blue-ground.'

After referring to the pyrope garnets, and suggesting that the various garnetiferous serpentines are doubtless derived from the decomposition of similar peridotites, as further indicated by their likewise containing olivine, bronzite, chrome-diopside, etc., he mentions another variety of garnets as found in this rock, very small, very brilliant, very hard, colorless or greenish, and extremely difficult to distinguish from small diamonds. These Professor Lewis is inclined to refer to demantoid. (?)

An interesting part of this discussion next follows, in relation to the perovskite, which is pretty abundant in small crystals, of cubical habit. Professor Lewis gives much attention, and a number of drawings, to the optical features of this species, and strongly inclines to the view that regards perovskite as a highly twinned orthorhombic mineral and not isometric save in external aspect. This has long been a mooted point, and these observations are an

important contribution. Of much interest also are the chemical and genetic relations of this species as here presented; the crystals often enclose grains of what Professor Lewis terms a titanic spinellid, perhaps a titaniferous magnetite, perhaps ilmenite, indicating a derivation therefrom; they also, in some cases, lie in a curious manner, upon or around partially altered olivine crystals. The remark is made that, while perovskite is familiar in various non-feldspathic igneous rocks, it has not been found in peridotite until Professor Williams recognized it in the peculiar rock from Syracuse, N. Y., and that later Professor Lewis identified it in the similar rock from Isom's Creek, Kentucky, where it had been previously regarded as anatase. These three rocks, those just named and the African, are the only known occurrences of what is here named Kimberlite. The article goes on to show that in basic eruptive rocks the titanium takes the form of perovskite, while in acid rocks it forms sphene; in intermediate ones it develops ilmenite or titanic iron; and these deductions harmonize precisely with important experiments of Bourgeois, in the artificial production of titanium minerals.

After going into some particulars as to the minor minerals found in this rock, Professor Lewis then takes up the base or ground mass and discusses it minutely. He terms it 'a more or less homogeneous serpentinous mass,' very difficult to study by reason of its decomposed condition, consisting now of a mixture of serpentine with calcite and some other products of alteration, the original structure being wholly lost.

Fragmental enclosures are frequent, 'both of the adjoining shale and diabase, and also of more deeply seated granite, gneiss, eclogite, and other related rocks.' Of these the shale predominates, sometimes making the rock a breccia. The shale itself is highly charged with carbon, so as to be quite combustible; but the included fragments are altered, having lost their carbon and become harder, sometimes even metamorphosed to a micaceous structure, as before referred to. In size they vary from large masses, in the upper part of the mines, called by the workers 'floating-reef,' to small fragments, diminishing in number and size in descending.

Professor Lewis goes into very detailed petrographical and chemical discussion as to the original character of the rock, in which it is hardly possible to follow him in a review, and finding no known rock that presents identical characters, he proposes for it the name of Kimberlite. This he designates as 'a porphyritic volcanic peridotite of basaltic structure,' and notes three forms of its occurrence: (1) Kimberlite proper, a typical porphyritic lava; (2) Kimberlite breccia, the same rock broken and crushed by volcanic movements and crowded with included fragments of shale; (3) Kimberlite tuff, the fragmental and tufaceous portion of the same rock. These varieties graduate into each other, and all occur together in the same neck or crater, the second, however, being most abundant and most productive of diamonds.

He treats of the origin of the brecciated structure, which has caused much discussion, some geologists regarding the whole rock as a sort of tufa or volcanic mud, while others hold that it is a true outpouring lava that has carried up fragments of the rocks broken through it its course, and has since been largely decomposed. Professor Lewis urges the latter theory strongly, and supports it by many arguments; while the editor, Professor Bonney, evidently inclines to the other view, advocated by Professor W. H. Hudleston, in 1885, and by some others. There is not space here to review Professor Lewis' several arguments for the true igneous character of the Kimberlite and against the tufaceous theory. The one to which Professor Bonney accords the chief importance is the identity of the rock with that from Syracuse, New York, and Elliott county, Kentucky, where it occurs in actual dikes, such as are not found in tufas. The brecciated character, which is so marked, is referred by Professor Lewis to three causes, acting either separately or perhaps together. These are (1) rapid cooling and shrinkage; (2) 'friction brecciation,' from contact with the wall-rock; and (3) subsequent movements and explosions in the crater itself, below. He illustrates and parallels the first of these from meteorites, to some of which

this rock bears marked resemblance both in structure and contents, and the others from well-known occurrences in terrestrial volcanic rocks.

The third section of the volume is occupied with a detailed account, from specimens and notes of Professor Lewis, of the two other known occurrences of Kimberlite, at Syracuse, N. Y., and Willard, Ky. The identity of these with the African rock, in almost all particulars, is remarkable, and as they form definite eruptive dikes, Professor Lewis' view as to the latter is strongly confirmed.

It remains only to call attention to other and later facts which tend to bear out the views presented in this remarkable posthumous article.

The presence of a residual hydrocarbon in the rock of the African diamond mines was shown by an interesting and important observation of Sir Henry E. Roscoe (Proc. Lit. and Phil. Soc. of Manchester, XXIV., 1885, p. 5), which is alluded to by Professor Lewis in his second paper, and has frequently been cited in discussions of the subject. He found that the 'blue-ground' on treatment with hot water yielded an aromatic hydrocarbon, which he was able to separate by digesting the 'blue-ground' with ether and evaporating the solution. It then appeared as a crystalline aromatic solid, burning with a smoky flame (showing it rich in carbon), volatile, and melting at 50° C.

The bearing of this fact upon Professor Lewis' theory is clear. It indicates that the igneous rock, breaking through the highly carbonaceous Karoo shales (37.50 p. c. of carbon; Whitfield, U. S. Geological Survey; Gems and Prec. Stones North America, 1889, p. 33) became charged with volatilized hydrocarbons distilled from the shale, and that in cooling these had crystallized partly into diamonds and partly into the many carbonadoes, larger and smaller, which are distributed through the rock. Professor Roscoe's material strongly suggests this theory, which, indeed, he himself independently propounded.

In 1886 a meteorite fell at Novo Urei (September 22d) in the province of Pensa, Russia, which was found to contain about 1 per cent. of diamond carbon, in the form of gray particles.*

In 1887 Mr. Fletcher (*Mineralogical Magazine*, 7, 121) described the new mineral 'Cliftonite' —a black substance with a hardness of 2.5 and a density of 2.12, occurring in cubes with faces of the dodecahedron or tetrahexahedron in the meteorite of Youndegin, West Australia. This suggested a graphitic alteration of diamond—a view taken by Brezina (*Ann. Mus. Wien*, IV., 102, 1889) regarding this new species and certain graphitic crystals of cubic type, observed long before in the Arva meteorite and regarded as pseudomorphs after pyrite by Haidinger (Pogg., 67, 437, 1846), but later by Rose, as after diamond (*Beschr. Meteor.*, 40, 1864). Similar crystals were also known in the Sevier iron of Cocke county, Tenn.

In 1891 the discovery of diamond, or at least of diamond carbon, in some quantity in the meteoric iron of Cañon Diablo, Arizona, was announced by the late Professor A. E. Foote (*Amer. Jour. Science*, Vol. XLII., July, 1891, pp. 413–417) and Dr. George A. Koenig. In July, 1892 (Science, p. 15), Dr. O. W. Huntington gave further experiments on the same material, confirming the decisions of Professors Foote and Koenig; and in December of the same year similar results were published by M. C. Friedel (*Bulletin de la Soc. Francaise de Mineralogie*, No. 9, p. 258). A crucial test was then proposed by G. F. Kunz, of New York, and carried out in the presence of Dr. Huntington, at the World's Fair at Chicago, September 11, 1893, viz., the cutting of polished faces on pieces of diamond with some of the carbon powder from the cavities of the Cañon Diablo meteorite (*Amer. Jour. Sci.*, Vol. XLVI., December, 1893; and Min. Resources U. S., 1893, pp. 683–685).

In the meantime Professor Henri Moissan, of Paris, had been making his now celebrated experiments on the artificial production of diamonds from the cooling, under extreme pressure, of highly carbonated iron fused in a specially constructed electric furnace (Mineral Resources U. S., 1895, pp. 903–904).

All these facts taken together form a remarkable series of confirmatory evidence of the views advocated by our late countryman in re-

* Daubreé's discussion of the analogy of the occurrence of the diamond in the meteorites and in the South African Kimberlite was the next important paper on this subject. (Comptes Rendus, 110–18, 1890.)

gard to the production of this most precious of gems, the origin of which has been so obscure a problem in mineralogy and geology. Another point of great scientific interest developed in the course of these investigations is the close similarity, both in composition and in structure, existing between some of these rarer igneous rocks of our globe and the extra-terrestrial visitants that come to us from space.

Mr. G. F. Becker, in a recent letter, takes a different view of this subject and holds that I have misinterpreted Professor Lewis, and that he did not regard the diamonds as due to carbonaceous matter taken up from the shales. He claims that "Lewis over and over again says that the diamond is as much a part of the Kimberlite as its other component minerals." It is true that he did use such an expression of 'the Kimberley rock' (p. 44); but this is in summing up his argument that the diamonds are in their original matrix, as against the early notion of their having been washed into the 'kopjes' from above, or the later theories of their having been carried up with the igneous rock from some deeper source below. The statement relates merely to 'the matrix of the diamond'—the subject of the article—not to the source of the carbon. Moreover, diamonds are not present in the Kimberlite of Syracuse, N. Y., or of Elliott County, Kentucky,* which Professor Lewis recognized as the same rock. He says (p. 56): "In mineral composition, in eruptive character, in structure, in enclosures, the three rocks are identical." It is plain, therefore, that he did not regard diamonds as an essential ingredient of Kimberlite. As to their source being carbon derived from the shales, it is true that Professor Lewis does not in these papers distinctly so assert, though he refers frequently and pointedly to the association of diamonds with the penetrated and included shales. But in personal conversation, at a period between the dates of his two papers, and before he had even heard of the very suggestive experiment of Sir Henry Roscoe, Professor Lewis expressed to the writer his definite belief that such was their origin. The knowledge of this fact may have led me to state this view as held by Professor Lewis more clearly than appears on the face of his paper, and doubtless explains the perplexity that Mr. Becker expresses as to how he and I can read the article differently.

Mr. Becker says: "I consider the diamonds as much a part of the Kimberlite as zircons are a part of granites." This may be Mr. Becker's view; and he is a high authority, with whom I would not lightly disagree; but it can hardly be claimed as the view of Professor Lewis, when he asserts (as above noted) the absolute identity of the diamond-bearing Kimberlite of Africa with the non-diamond-bearing rocks of Syracuse and Kentucky. The question is not whether the diamonds (in Africa) are 'a part of the Kimberlite.' Undoubtedly they are so, there; but how came they to be so at that locality and not at the others? This subject was fully discussed by the writer in 'Gems and Precious Stones of North America,' pp. 32–34, in connection with the examinations made by Mr. Diller and myself in 1887, as to the possible occurrence of diamonds in Kentucky, as suggested by the similarity of the rock. It was there shown that, while the shales penetrated by the African Kimberlite had 37.50 per cent. of carbon, those traversed by the Kentucky Kimberlite contained but 0.68 per cent. The same rock breaks through a body of shale in two localities, the one rich in carbon, the other poor; the intruding rock is fitted with diamonds in the former case and none appear in the latter. And why did Lewis search everywhere for localities where serpentines and peridotites occurred associated with coal formations?

Professor Lewis observes (p. 8): "The rock (at Kimberley) appears in two types, one not bearing diamonds, the other diamantiferous, and the distinction between them is suggestive. Both occur in the same mine and are dark, compact, heavy rocks, closely resembling one another and differing mainly in the fact that one is free from enclosures of foreign substance, while the other is full of fragments of shale and other impurities. It is the latter which is diamantiferous." On p. 46 he notes the fact that the fragments of shale included in the igneous rock have lost their carbonaceous matter; and

* Is there a diamond field in Kentucky? J. S. Diller–G. F. Kunz, SCIENCE, Vol. X., 1887, pp. 140–142.

on p. 51 he cites as of great interest the observation and experiment of Professor Roscoe, elsewhere noted, as to the extraction of a hydrocarbon from the 'blue ground.' These references alone would indicate Professor Lewis' views, even apart from his own statement of them to the writer.

Mr. Becker also alludes to the broken crystals, as repeatedly seen by him in separate fragments enclosed or embedded in the rock, and as not being considered rarities at Kimberley. These occurrences, however, may well be due to the very causes treated of by Professor Lewis in explaining the brecciated character of the rock (p. 54 and above noted), especially the first and third, the latter in particular, 'subsequent explosions and movements in the crater' below. Any such action sufficient to break up the Kimberlite into the likeness of a breccia would easily shatter the highly cleavable diamond crystals and bring about the condition seen and described by Mr. Becker.

It may not be out of place here to recall an instance where, in another locality, the occurrence of diamond may be connected with a similar outbreak of igneous rock through beds containing carbon. In a paper, 'On Bohemian Garnets,' read by me before the American Institute of Mining Engineers, and published in their Transactions for February, 1892, mention was made of a diamond crystal found in 1870 at Dlaschkowitz, Bohemia, among a number of the pyrope garnets which are derived from the decomposition of peridotite rock. After being disputed and identified, it was deposited in the public museum at Prague, where I examined it, as well as the locality where it was found. The decomposed serpentinous rock has evidently been transported from the north (probably by glacial action) and there are found, at a distance of twenty or thirty miles in that direction, basaltic outflows that have broken through the coal measures. Here, again, is a suggestion of similar conditions, and the occurrence of this single crystal is not without interest in such a connection, as may be a Ural crystal at Chitanka, where I identified serpentine and pyrope, but not any carbonaceous materials, as my time was very limited.

It is a matter for national pride that this remarkable investigation should have been made by an American scientist; and a debt of gratitude is due both to the great English meteorologist—the editor, Professor Bonney—for his labor of love, alike to science and to a deceased friend, and also to Mrs. Lewis, who has so carefully sought to prepare and make public these papers of her brilliant and lamented husband.

GEORGE F. KUNZ.

NEW YORK.

NEW BOOKS.

System der Bakterien. DR. W. MIGULA. Jena, Gustav Fischer. 1897. Pp. viii+368 and 6 plates.

Manual of Bacteriology. ROBERT MUIR and JAMES RITCHIE. Edinburgh and London, Young Pentland; New York, The Macmillan Company. 1897. Pp. xvi+519. $3.25.

The Calculus for Engineers. JOHN PERRY. London and New York, Edward Arnold. 1897. Pp. vi+378. $2.50.

Theory of Electricity and Magnetism. CHARLES EMERSON CURRY. London and New York, The Macmillan Company. 1897. Pp. xvi+442. $2.50.

Organic Chemistry for the Laboratory. W. A. NOYES. Easton, Pa., Chemical Publishing Company. 1897. Pp. xi+257. $1.50.

The Psychology of the Emotions. TH. RIBOT. London, Walter Scott, Ltd.; New York, Charles Scribner's Sons. 1897. Pp. xix+455. $1.25.

Hallucinations and Illusions. EDMUND PARISH. London, Walter Scott, Ltd.; New York, Chas. Scribner's Sons. 1897. Pp. xiv+390.

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Introduction to Philosophy. OSWALD KÜLPE. Translated by W. B. PILLSBURY and E. B. TITCHENER. London, Swan, Sonnenschein & Co.; New York, The Macmillan Company. 1897. Pp. x+256. $1.60.

Volcanoes of North America. ISRAEL C. RUSSELL. New York and London, The Macmillan Company. 1897. Pp. xiv+346. $4.00.

SCIENCE

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Friday, September 24, 1897.

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THE GROUNDWORK OF DYNAMICS.*

The subject of dynamics is too often treated as if its chief value consisted in the opportunities it affords for familiarizing the student with the operations of the differential and integral calculus. It is regarded as a department of applied mathematics rather than of mechanical science. That this should be the case is unfortunate; at the same it is not in the nature of things altogether avoidable. The student cannot afford the time involved in deferring the study of dynamics until he has acquired a working knowledge of the calculus. As a consequence he becomes confused respecting the origin of his difficulties, and possibly attributes to his ignorance of mathematics misconceptions the nature of which may be purely dynamical. It would be of great benefit to him to have the opportunity of attending, before the close of his studies, a short course of lectures on the fundamental principles of the subject, that is to say, the conceptions springing directly from experience, upon which the science is founded. The mind of the individual resembles in its mode of growth the mind of the race. The study of the historical development of mechanical ideas will go a great way in clearing up difficulties which arise from adhering too closely to one line of thought. Many of the greatest advances in science are the result of changes of the point of view. Such changes correspond in some measure with the process known to the mathematician as the transformation of coordinates, a process which often transforms a mass of brain-wearying symbols into ordered groups, instinct with life and

*Address by the Vice-President before Section D. of the Detroit Meeting of the American Association for the Advancement of Science.

meaning. It will be well, therefore, for the student of dynamics occasionally to make the endeavor to transform his coordinates and view the subject from different standpoints. For this purpose it is unnecessary that he should be an expert in refined mathematical analysis. It is requisite, on the other hand, that he should possess, in some degree, what may be called the mechanical instinct. The whole power of modern analysis has not proved sufficient to solve, in its generality, the problem of the three bodies; a problem extremely useful, nevertheless, as an illustration of dynamical principles.

The science of statics, or the laws of composition of forces and couples, was developed from rude experiments made with springs and with strings and weights; the tensions of the strings being measured by the weights. The conditions necessary in these experiments were that the body to which the springs or strings were fastened should be maintained by them at rest, and that all changes of shape and size should have ceased. Statics was thus established without the introduction of the ideas of mass and acceleration. In this stage, however, its laws were supposed to apply only to rigid bodies at rest. The facts to be noted are, that force was recognized as a fundamental conception, and that methods of measuring it and the laws of composition of forces were discovered, without reference to motion except in the respect that rest was supposed to be a necessary condition.

The connections between force and motion, the subject-matter of dynamics, were established by observing the motions of falling bodies, pendulums, bodies rolling and sliding down inclined planes, colliding spheres, bodies connected by strings running over pulleys, etc. In making these experiments it was necessary to know the forces acting. As the only scientific knowledge of force at the time was contained in the laws of statics, the assumption was made that these laws were true, even though the bodies were moving and whether the velocities were increasing, decreasing, or changing in direction. This was a change of the point of view which was fruitful in important results. It was found, however, that while the above assumption was justified in the case of the composition of forces, and in the case of weights when considered as forces acting on the heavy bodies themselves, it was not true to assume that the tension of a string in motion is measured by the attached weight. The true indication of the tension in a string was recognized to be the same as in the case of a spring, viz., the elongation. Again, while in statics, the principal objects were the strings and weights, and the bodies to which they were attached were of little or no account, in the dynamical experiments the bodies assumed importance. The conception of mass was introduced, and was found to correspond with the commercial idea of quantity of material, as determined by the balance and weights. The results of these experiments are contained in the laws of dynamics, or the laws of motion, as they are usually called, which may be summarized as follows:

I. That no change in a body's motion of translation takes place except by the action of external forces.

II. That external forces impress on a body changes of momentum in their own directions at rates proportional to their magnitudes.

III. That action and reaction are equal and opposite, and in the same line.

It seems to be a matter of doubt whether Newton, in his statement of the laws of motion which I have thus paraphrased, intended to affirm that action and reaction are in the same line. Whether there be ground for this doubt or not, the idea is

implied in D'Alembert's principle and is accepted as true.

The third law is a law of force, the value of which is seen when the mutual actions of bodies are to be considered. Without this law the laws of statics and of motion would refer to actions on one body only.

It was evident that the laws of composition of forces could be considered as corollaries of the laws of motion, so that from the latter a more comprehensive view of the measurement of force was gained than from the statical experiments. Thus the statical method of measuring force by balancing the tension of one string or spring against that of another was interpreted dynamically, by assuming that the body upon which the springs acted remained at rest in consequence of receiving from the forces opposite changes of momentum at the same rate. It followed that if the springs were to act singly they would, other things being equal, produce equal rates of change of momentum. Thus dynamics furnished a new method of measuring forces which agreed with that by means of springs.

Further investigation in the light of the new principles showed that the method of measuring forces by weights agreed with the spring measurement and with the dynamical measurement when the condition was observed that the weights were kept in the same locality, but in general not otherwise. Dynamics gave an explanation of this anomaly by showing that the forces of the weights were due to gravity, which evidently might change in intensity from place to place, although the masses of the weights remained unaltered. The measurement of force by weights was thus shown to be a special case of the general dynamical method. Also it resulted that the measurement of force by weights was in principle the same as the measurement by springs, the weight and the earth together constituting a spring whose elastic force is gravity.

It is of little use in the early dynamical training of a student to dwell on the fact that the unit of force in dynamical measure is a force which produces unit acceleration in unit mass. It may even do harm. It may have the effect of leading him to believe that the refined methods of measuring force by means of weights and springs, which are the only methods used in the laboratory, are wrong and that the testing machines and pressure gauges of the engineer are beneath contempt. It ought to be impressed upon him that all the methods of measuring force approved by experience are equally scientific and equally absolute, and will give exactly the same results, aside from unavoidable experimental error, provided that the proper conditions in each case are observed; also that the choice of the method depends, just as in the case of everything else in life, upon the objects in view and the circumstances.

We now come to the period of the development and extension of the laws of motion. While proved in the case of small bodies and motions of limited range, it by no means followed that they applied to the motions of the tides or of the planets. Newton, by the aid of his happy intuition, the law of gravitation, put new meaning into them and extended their jurisdiction over all visible and measurable motions within the solar system.

All motion is, so we are taught, relative; and the motion which is uniform and in a straight line with reference to one set of axes may be varying and in a very crooked line when referred to another set, and perfect rest with regard to a third set. The question then is, for what axes are the laws of motion true? It is very certain that the stresses in the springs by which forces are measured are in no wise affected by the choice of axes of reference.

Imagine a cube of rubber, with several points marked on its faces, and consider the lines joining one of these points with the others. The angles between these lines measure the relative directions of the terminal points from the initial point. Now set the cube in motion ; stresses and strains are generated, in consequence of which the relative directions of the lines undergo small alterations. Why do these changes of direction remain within small limits? Evidently on account of the nature of the material connecting the points.

Consider now another system of points whose relative directions as time goes on remain almost unchanged, viz., the fixed stars. Is it possible that they may be moving like the points on the rubber cube? Observational astronomy indicates that they are at immense distances from the earth and from each other. If the law of gravitation holds for them their mutual attractions must be so feeble that they form a practically unconnected system. The constancy of their relative directions cannot therefore be accounted for as in the former case by the action of the matter between them, but must be attributable to some other cause. The distinction between the two cases, which is very real, is recognized by assuming that a line may have absolute direction; and the stars are said to preserve their absolute directions from the earth. Again, the assumption that both the law of gravitation and the laws of motion are true for the solar system leads to the result (in consequence of its vast distance from the stars) that its center of mass has little or no acceleration; in other words, is either at rest or in uniform motion in a straight line.

Now, although the ideas of absolute direction and absolute rest or uniform motion in a straight line may from the kinematical point of view be incomprehensible, yet in dynamics these terms indicate very definite facts. It is only by the choice of the center of mass of the solar system as origin and by using the stars to fix the directions of the axes that it is possible to make the observed motions of the planets fit, at the same time, the law of gravitation and the laws of motion. It is unnecessary to enter into the details of the work; suffice it to say, it is a process of trial and error, of assumption, computation and check by observation.

The following dynamical consideration enables, in certain cases, a more convenient origin to be used than the center of mass of the solar system.

If equal accelerations are impressed on the bodies whose motions and mutual forces are under consideration, by the attraction of the remainder of the solar system, it is evident that their motions referred to an origin at their common center of mass, with axes fixed in direction by the stars, will be affected only by their mutual actions. Also assuming the laws of motion to apply, these motions so measured will show the whole effect of their mutual actions, since the latter have no effect on the motion of their center of mass. It is thus, possible, in discussing the lunar tides, to use as origin the center of mass of the earth and moon, and in the case of terrestrial bodies the center of mass of the earth. It may be noted that whether the primary origin or such subsidiary origins be used, the equations for the mutual forces under consideration are the same; the effect of the change of origin appearing only in the constants of integration. It will be convenient to term all such sets of axes, including the primary set, absolute axes.

It now remains to determine whether the absolute axes will give results agreeing with those already obtained in the small scale experiments, with axes fixed in the earth; and if they do not, whether the discrepancies can be explained.

If no explanation could be given of such discrepancies it is evident that the science of dynamics would be resolved into a bundle of empirical rules, describing the various axes of reference that applied in different cases, and the range of applicability in each case.

In order to make the comparison, it will be necessary to obtain the data required for transformation from the absolute set of axes with origin at the earth's center, to axes fixed in the earth with origin in the locality of the experiments. These data are furnished by astronomical observations. When the transformation is made there appear on the left-hand side, let us say, of the equations the rate of change of momentum of the body relative to the axes fixed in the earth, and on the right-hand side the attractions, tensions and other impressed forces, together with certain terms involving the relative motion of the two sets of axes.

In the equations of the original experiments no terms of the latter kind occurred. There are three ways of accounting for the difference. Either the forces are different in the two sets of equations, or the new terms are so small as to be within the limit of experimental error, or each experiment or class of experiments requires its special set of axes.

Experience shows that the explanation lies in the first or second alternative; the the third is not true.

These terms are generally negligible in laboratory experiments. It is necessary to consider them in the theory of winds and ocean currents. Their presence in the equations has suggested certain experiments with pendulums and gyrostats, which confirm their truth. We are justified by experience, for instance, in believing that in the northern hemisphere moving bodies tend to the right, in the southern hemisphere to the left; bodies moving eastward tend to rise, westward to fall; and that bodies, whether at rest or in motion, tend to move outwards from the polar axis. All such tendencies are represented by the terms under consideration. They may be regarded when written on the force side of the equations as representing relative or fictitious forces; fictitious because they correspond to no actions of matter, but are the consequence simply of the motion of the axes of reference relative to the absolute axes.

Sometimes it happens, as has been indicated, that the discrepancy lies in the fact that the forces in the two sets of equations are different, although referring to the same experiment. Consider the case of a body suspended from a spring. Referred to axes fixed in the earth it is at rest, and the inference is that the attraction of the earth is equal and opposite to the tension of the spring. Referring, however, to the same axes by transformation from the absolute axes, there appears, in addition to the terms representing the tension of the spring and the attraction of the earth, a new term, a relative or fictitious force, known as the centrifugal force. The inference now is that the attraction of the earth is greater than the tension of the spring, instead of being equal to it. If this inference be accepted as the true one the question arises, which of the original forces was wrong, or were both astray? Remembering that the intrinsic indication of the force exerted by the spring is its elongation, and that of attraction the acceleration caused by it, also that acceleration depends on the choice of axes of reference, while the elongation of a spring does not, there can be no hesitation in deciding that the error lay altogether in the estimate of the attraction. The fictitious force, while itself invisible, also rendered invisible a portion of the earth's attraction. By using proper axes of reference its true character is revealed and

its power for evil destroyed. If the mechanism of attraction were not concealed, or if it had some distinguishing mark other than acceleration, and it were possible to experiment with it as with springs, such an error could not be made, even with improper axes of reference.

A convenient way of regarding the laws of motion is to consider, as before, the second law as affirming the relation between force and change of momentum, and the third and first as asserting the principle of conservation of momentum; the third implying that momentum passes from one body to another without change, and the first that the only way by which the momentum of a body can suffer alteration is by part of it passing into another body. Again, if it be assumed that the third law implies that action and reaction are in the same straight line the principle of the conservation of angular momentum will follow.

The statement is sometimes made that the 'bodies' of Newton's laws must be regarded as particles. I cannot take this view; they are real bodies, of all sizes, and with all the qualities known and unknown of such bodies. They are not the imaginary bodies of the mathematician, the dramatis personæ of the algebraic theatre, possessing only the qualities arbitrarily assigned to them for the special purpose of the investigation in hand.

The laws of dynamics thus hold for all bodies within the solar system whose masses, forces and motions have hitherto been observed and measured; but the motions must be measured with essential reference to only one set of axes, namely, a set whose origin is in the sun and whose directions are fixed by the stars.

Kinematics deals with relative motion; Dynamics with the 'Motus Absolutus' of the Principia.

We now pass to the consideration of the laws of energy in their dynamical relations.

In the discussion of statics as the forerunner of dynamics, attention was directed mainly to the springs and strings and weights by which the forces were measured. The original statical experiments may also be regarded as the source of the principles of energy in connection with mechanical science. From this point of view the bodies upon which the forces act come into prominence, not because of their masses as in dynamics, but on account of their shapes, sizes and rigidity. Thus the experiments were made with levers, pulleys, inclined planes, wedges, etc.—in fact, with instruments for doing work, the mechanical powers of the text-books. In the statical principle of virtual velocities we have the origin of the principle of the equivalence of work and energy. To men of all times the most natural way of regarding force has been, as the action by which material is stretched, bent, twisted, broken or displaced, *i. e.*, whereby work is done. Even the word momentum, in the language of ordinary life, implies the power of doing work. It is worth consideration whether it may not be better in the instruction of students to work up to the ideas of dynamics through elementary examples of the equivalence of work and kinetic energy, rather than by taking the ordinary balloon passage to the laws of motion. While less systematic and formal, this procedure would be more natural and probably more useful.

The laws of energy may be summarized as follows. When work is done on a body an equivalent amount of energy is partly transformed and partly transferred without transformation. It is in general partly transmitted to other bodies with which the given body may be in physical connection. Its transformations are into stored energy and dissipated energy. Examples of stored energy are the potential energies due to gravitation, the forces of elasticity, magnetic and electrical attractions and

molecular forces. Such forces are termed conservative. Kinetic energy is another form of stored energy. Energy is dissipated by means of the forces of viscosity and friction, known as dissipative forces. Energy is also stored and dissipated in certain electrical, electro-magnetic, thermal, chemical and other actions which have not been identified with force and which, therefore, are not dynamical.

In order that work may be done there must be a source of energy, or place from which it comes, and a sink, or place to which it goes, together with an energy stream from the source to the sink. When work is done continuously the energy stream is accompanied by a circuit or system of stored energy which acts automatically as a moderator of its fluctuations.

The principle of conservation affirms that energy can neither be created nor destroyed, so that its changes are changes in form but not in amount.

The principle of the equivalence of work and energy is analogous to the second law of motion, considered as expressing the equivalence of impulse and momentum; that of the conservation of energy has its analogue in the third and first laws of motion regarded as affirming the conservation of momentum.

Newton notices this analogy in his scholium to the laws of motion in the words, "just as bodies in cases of collision have the same effect, whose velocities are inversely as their masses, so in putting machines in motion agents have the same effect, whose velocities in the directions of their forces are inversely as these forces." The now well known reference in the same scholium to the action of machines, the importance of which was pointed out in Thomson and Tait's Natural Philosophy, was in continuation of the same line of thought.

The impulse or time integral of a force is fully accounted for by the change of momentum, while the work or displacement integral is only partially accounted for by the change in kinetic energy, in all cases of real bodies. The reason for the difference is that the laws of motion are a complete statement of our experience of force in relation to the motion of a body as a whole, *i. e.*, the motion of its center of mass. On the other hand, the laws of energy require the consideration not only of this motion, but also of all internal motions and forces.

The principle of the equivalence of work and energy is a statement of an effect of force essentially different from its effect in producing change of momentum. It might be supposed, therefore, that this principle would be useful in affording another means of measuring force. The impossibility, in general, of measuring the whole change of energy due to an unknown force acting through an observed distance renders this idea to a great extent fruitless. If the laws of energy are true such a method of measuring force must give the same result as the dynamical method. The measurement of force by springs is based on this principle, and not on the second law of motion. Although no attempt is made to measure the change of energy due to the work of extending a spring, yet experience goes to show that the energy changes due to given extensions made in the same order are constant, and hence the corresponding forces are constant.

The connection between the laws of energy and those of motion may be stated as follows: Energy and work, like force, are fundamental conceptions gained from experience and having various relations with phenomena which can be discovered only as a result of experiment and observation. One of these relations is that work is proportional to the product of force into displacement. This relation is, therefore, a natural law, of the same order of impor-

tance as the second law of motion, and not a mere verbal definition. Experience thus gives a dynamical measure of work as well as of force.

The law of equivalence of work and energy then establishes work as a dynamical measure of energy.

The laws of motion, combined with this law of energy, establish the result that kinetic energy is proportional to the product of momentum and velocity, and thus furnish a dynamical method of measuring energy in its kinetic form. This is the sole contribution of the laws of motion to the science of energy.

It is only in the case of bodies whose internal forces and motions are known, or determinable from assumed data, in other words, imaginary bodies, that the laws of energy, as far as they are considered in dynamics, are included in the laws of motion and therefore become unnecessary, except for the purpose of convenience in mathematical analysis, or economy of thought. Even in such cases the expressions for work and energy retain a flavor of their original meaning and do not altogether degenerate into mere mathematical symbols.

The science of dynamics, as it is understood at the present day, includes among its fundamental principles, in addition to laws of motion, the principle of the equivalence of work and energy, and the principle of the conservation of energy; energy being measured, however, only in terms of force and displacement, or momentum and velocity.

The only actions known in dynamics are force and its integrals, impulse and work. To identify with these all other actions involving the transfer and transformation of energy, such as the conduction of heat, chemical reactions, induction of electric currents, etc., forms to-day the severest task of mathematical physics.

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MATHEMATICS AND PHYSICS AT THE BRITISH ASSOCIATION.

MEETING this year at Toronto in the week immediately succeeding the meeting of the American Association at Detroit, the British Association had the advantage of securing the attendance of a number of distinguished American scientists, who added greatly to the strength and interest of the proceedings. Taking Section A alone, it is sufficient to mention the names of Dr. Hill, Professors Michelson and Newcomb, as Vice-Presidents; and of Professors Barker, Carl Barus, Bedell, Carhart, Merritt, Nichols, Rosa, and many others who attended the meetings and assisted at the discussions in the work of the Section.

It is generally conceded, even by the rival sections, that A is not only the first but also the most strongly represented section, if not always in the number of its rank and file, at least in the distinction of its leaders and in the vigor and extent of its work. This year, in spite of the distance from home, formed no exception to the rule. Although some familiar faces were absent, the section formed a very strong and representative gathering of mathematicians and physicists. There were no less than fifty names on the committee, but it would have been easy to add to this number without going beyond the list of those attending the meeting whose work was already known.

In many ways, the extremely varied interests which the Section A represents are doubtless a great element of strength, but there are certain drawbacks in its excessive vitality. It brings together men from a number of different but closely allied departments of knowledge, who, if they did not possess some such common meeting ground, would be less able to keep in touch with each other, and to assist in the general advancement of science. At the same time it cannot be denied that the section is somewhat overburdened with an excess of com-

munications which are too good to refuse, and that in consequence of the press of work and of the extremely mixed character of the audience, the discussions on the various papers, which should be the most valuable and interesting part of the proceedings, are generally of a very perfunctory and almost casual order. Similar considerations lead to the curtailment of the papers as well as of the discussion. Many of the authors are influenced by an undue regard for the feelings of the more popular part of the audience, and are thus impelled to omit technical details of the highest interest and importance for the due appreciation of their work by those competent to judge.

Upwards of 60 communications, out of many more that were sent in, were accepted and read in the course of the five days on which the section met. In order to get through this program, it was necessary to sit till 3 p. m., on many of the days, without any intermission for lunch. On two of the days the section divided into two departments, Mathematics and Meteorology on Monday, Electricity and General Physics on Tuesday. This plan has been found to work well in previous years, but is not without its defects. Professor Rosa, for instance, was engaged in reading a paper in one department at a time when another of his communications was due in the other. He was thus compelled to miss the reading and discussion of a number of papers closely allied to the subject of his second communication, and those present in the electrical department were compelled to miss the description of his most ingenious and complete electrical calorimeter as applied to the verification of the law of conservation of energy in the human body. Under any system of subdivision, it is probable that similar difficulties must occasionally arise, but the question is now under the consideration of a special committee, and it is hoped that some more perfect arrangement may be evolved in time for the next meeting.

An audience of over four hundred assembled in the Chemical Lecture Theatre to hear the address of the President, Professor A. R. Forsyth, who succeeded Cayley in the chair of pure mathematics at Cambridge. His address was an eloquent and convincing vindication of the importance of studying mathematics for its own sake with the single aim of increasing knowledge, and not, as some would have it, from a utilitarian point of view, as an instrument for the use of the engineer, the physicist or the astronomer. The path of practical utility, as he justly remarked, is too narrow and irregular, not often leading far. It is evident from the demeanor of the audience that they were all thoroughly interested and engrossed in the subject of the address, which, it is to be hoped, may do something to moderate the utilitarian and technical spirit, and to check its inroads upon the sanctuaries of university education.

The ventilation of the Chemical Lecture Theatre appears to have been overlooked in its construction; but, in spite of a somewhat asphyxiating atmosphere, the larger, and, we may also say, the wiser part of the audience, remained behind to hear the presidential address of Professor Ramsay to the Chemical Section, on 'An Undiscovered Gas.' Professor Ramsay is a physicist no less than a chemist, and his search for the undiscovered member of the triad of which helium and argon are the extremes, raised many questions of the widest general interest to the physicist as well as to the chemist. The methods which he was compelled to adopt in treating these substances, which have no chemical properties, were also physical rather than chemical, depending on differences of density, refractivity, and rate of diffusion. Helium appears to be unique among elements in possessing an extremely low refractivity in proportion to

its density. The physical methods of diffusion, and of measuring and comparing the refractivities of different gases and mixtures of gases, appear to have been carried to the highest degree of refinement which has yet been obtained, in this nominally chemical research.

After adjourning to the Physical Lecture Theatre, the section took up the ordinary business of the meeting. A paper was read by J. A. Paterson, 'On the Unification or Time,' a question of considerable interest to Canadians. In the discussion, it was pointed out by Professor Rucker that, for the present, international agreement was hopeless. The question had recently been considered by an influential committee of the Royal Society, who had decided that the present was not a suitable time for action. A committee was subsequently appointed by Section A to consider what action could be taken in the matter.

Professor Rucker, assisted by Forsyth and Sowter, showed some photographic records which had been obtained of objective Combination Tones, which were of great interest in connection with certain disputed points in the theory of such tones.

The report of the Committee on Seismological Observations was read by the Secretary, Mr. J. Milne. Among the points specially discussed were the greater frequency of sub-oceanic disturbances as compared with land-quakes, the large number of such movements originating in Tuscarora Deep being taken as a special example. It had also been shown by means of observations of earthquakes taking place in various parts of the earth, and registered by means of one of Milne's horizontal recording pendulums for unfelt earth-movements, that the velocity of propagation of such movements was much higher through the lower strata. The nearer the path to the center of the earth, the higher the velocity. By means of several of these instruments, which are now being set up in different parts of the globe, it is hoped to obtain important information with the regard to the interior constitution of the earth. Such records have also been proved to be of great practical utility in connection with the breaking of submarine cables, and other effects of suboceanic disturbances.

On Friday a paper was read by Dr. N. E. Dorsey, 'On the Determination of Surface Tension by the Method of Ripples.' Dr. Dorsey had applied the method used by Lord Rayleigh with great refinement to the measurement of the surface tension of water and of dilute aqueous solutions. He found that the surface tension was approximately a linear function of the concentration.

Professor H. L. Callendar and H. T. Barnes, of McGill College, Montreal, described their new method of determining the 'Specific Heat of a Liquid in terms of the International Electrical Units.' The practical details of the method have already been completely worked out, and several sets of observations have been taken in the case of water and mercury. The method consists in passing an electric current through a current of liquid flowing in a fine glass tube enclosed in a glass vacuum jacket, which is exhausted as perfectly as possible, and then hermetically sealed. The electric energy is measured by the potentiometer method in terms of the Clark cell and the Standard Ohm. The heat generated is measured by observing the flow of liquid and the steady difference of temperature between the ends of the fine tube. The time of flow is automatically recorded on an electric chronograph on which a standard clock is marking seconds. The difference of temperature is given by a single reading on a pair of differential platinum thermometers.

The method was primarily devised for the purpose of investigating the question of

the rate of variation of specific heat with temperature, which could be determined independently of the absolute value of the Clark cells used in the work. It is also of special interest in connection with the recent proposal of the Electrical Standards Committee of Section A to adopt the Joule or Watt-Second as the absolute unit of heat. According to the most recent reductions, the result of Rowland by the mechanical method, and of Griffiths and Schuster by the electrical method, for the specific heat of water differ by about one part in 400. This discrepancy is possibly due to an error in the value assumed for the Clark cell, but it is interesting to verify the comparison by a totally different method of calorimetry, to avoid any possible errors which may have remained unsuspected in the ordinary method, in which a known mass of water is heated through a certain range of temperature. In the method of Callendar and Barnes the temperature conditions are extremely steady, and observations can be taken under the most favorable conditions. The external loss of heat is reduced to a minimum by means of a vacuum jacket, and can be very accurately measured by varying the electric current and the flow of liquid in a suitable manner. Since there is practically no change of temperature, the correction for thermal capacity of the calorimeter is negligible.

A crowded audience assembled to hear Lord Kelvin on the 'Fuel and Air Supply of the World.' The address, which lasted about half an hour, was very characteristic, especially in the humorous attack on the English system of measures. Assuming that the earth was originally at a high temperature, and that there was at first no free oxygen in the atmosphere, it may be concluded with a high degree of probability that the present store of oxygen has been evolved by the action of sunlight on vegetation. To every three tons of oxygen there corresponds on the average one ton of coal or of fuel derived from vegetation. As there are at present two tons of oxygen to every square meter of the earth's surface, the total oxygen supply may be estimated at about one thousand million million tons, and the total fuel supply at 340 million million tons. According to the estimates of the Coal Supply Commission of 1831, it appears that England, with an area equal to one two-thousandth part of the earth's surface, possesses more than its share of fuel, the greater part of which is available for working. As the coal is used up, if it were not for increasing vegetation, we should be more likely to die from want of air than from want of coal.

Dr. Alexander Johnson, of McGill College, followed with a plea for an Imperial Hydrographic Survey. A committee of the British Association appointed at his suggestion in 1884 had succeeded in inducing the Canadian government to make a grant for the promotion of tidal observations. This grant has recently been reduced, and there was some risk that it might be discontinued altogether at a time when such observations were of special importance. At Professor Johnson's request an influential committee was again appointed to seek the cooperation of the Admiralty in establishing a permanent department.

Professors Ewing and Dunkerley, of Cambridge, England, contributed a paper on the 'Specific Heat of Superheated Steam.' They adopted the method of the throttling calorimeter, which is not so well known in England as in America, but instead of determining the wetness of the steam in terms of the degree of superheating observed they used a separator, and assuming the steam to be dry, deduced the value of the specific heat. A roll of silk was used, following Thomson and Joule, instead of an aperture for throttling the steam.

Professors Runge and Paschen contributed a note in continuation of their well-

known spectroscopic investigations. They find that the spectrum of oxygen consists of six series of lines, two principal groups each with two subordinate groups, having harmonic relations to each other. The spectrum of oxygen is thus analogous to that of helium. At one time it was supposed that this character of the spectrum might indicate that the substance examined was really a mixture of two different elements closely resembling each other in properties. Many elements, such as sodium and lithium, give only one series of lines. This hypothesis has, however, been recently abandoned.

W. J. Humphreys next read a paper on 'Changes in the Wave-Lengths of the Lines of Emission Spectra of Elements.' The changes examined were caused by increasing the pressure of the air surrounding the electric arc up to six or twelve atmospheres, which was found to produce a shift of the line towards the red end of the spectrum, the amount of the shift being nearly in direct proportion to the pressure, and never exceeding a tenth of an Angstrom unit for the pressure employed. The shifts were in general proportional to the wave-length, but different series of lines were differently shifted. Shifts of similar lines of different elements are said to be inversely as the absolute temperatures of the melting points of the substances, proportional approximately to the products of the coefficients of linear expansion of the solid and the cube root of the atomic volume. The effect is, therefore, like the atomic volume, a periodic function of the atomic weight. It is considered that some of these relations may be accidental, as most of the time was spent in measuring the lines and not in hunting after empirical relations.

In making the measurements, the best spectroscopic equipment of the Johns Hopkins laboratory was used. Besides a number of eye observations, several hundred photographs were taken, and almost every known metallic element examined. The shifts due to pressure may be distinguished from those due to the Doppler effect, because different lines of the same element are differently shifted, and the direction of the shift is always to the red. The largest shift observed would correspond to a velocity of recession of some four miles a second.

A communication from Professor Schuster, 'On the Constitution of the Electric Spark,' described measurements of the velocity of translation of metallic particles in the spark. The velocity found was from 400 to 2,000 metres per second.

Professor S. P. Thompson showed some experiments on varieties of cathode rays, which he classified according to their powers of exciting X-rays, of producing fluorescence, and of being deflected or not by a magnet. The ordinary cathode rays after reflection from the anticathode were found to be still fluorescifiant and deflectable, but to have lost their power of exciting X-rays. A third variety was produced by passing the cathode rays through a negatively electrified spiral or sieve, which changed the nature of the fluorescence and rendered them non-deflectable. A fourth variety was found in the funnels of a Holtz tube. Under the hurried conditions of the section meeting, it was not very easy to follow and observe these several effects.

Among the other papers on Friday were two by Professor S. P. Thompson, on a 'Tangent Photometer,' and on an 'Experiment with a Bundle of Glass Plates.' There were also two important contributions from John Hopkins on the comparison of the thermometers used by Rowland in his determination of the mechanical equivalent of heat (1) with the Paris Hydrogen Scale, and (2) with the scale of one of Callendar and Griffiths' platinum thermometers. The results of these experiments were to show that, when reduced to the same thermometric scale, the results of Rowland for the

rate of variation of the specific heat of water were in agreement with those of Griffiths, but there was a difference of about one part in 400 in the absolute value at any point. This point was particularly referred to in the Report of the Electrical Standards Committee, and it was suggested that the discrepancy might be due to an error of 0.1 % in the assumed value of the electro-chemical equivalent of silver.

The last paper read was by Professor H. L. Callendar and N. N. Evans, 'On the Behavior of Argon in X-Ray Tubes.' The authors had expected to find that pure argon, in consequence of its inertness and its supposed monatomic character, would give a very constant vacuum in such tubes. They found, however, that if the gas were very carefully dried, the resistance of the tube increased very suddenly, and the electrodes were melted or spattered over the walls as the vacuum approached the X-ray stage. The presence of residual hydrogen appeared to be necessary to enable the discharge to pass from the cathode to the gas. These effects were substantiated by experiments with other gases.

On Saturday the majority of the members dispersed on excursions to Niagara and various other places of interest, and with the exception of the Geological Section there were no meetings.

On Monday the section divided into two departments, Meteorology and Mathematics, and those specially interested in electrical work repaired to Section G, which devoted itself on this day to electrical questions. In the meteorological department papers were read by John Hopkinson 'On Monthly and Annual Rainfalls at Ten Stations in the British Empire, 1877 to 1896.' It appears doubtful, however, whether so listed a series of observations can be taken as representative of the pluviology of the Empire. By Dr. Van Rijckevorsel 'On the Temperature of Europe.' From certain peculiar maxima and minima exhibited by the curves of daily temperature, he considers that the continent may be divided into two regions in which a different type of weather prevails. R. F. Stupart, the Director of the Meteorological Service of Canada, contributed a paper on the 'Climatology of Canada.' F. Napier Denison, from a comparison of simultaneous records of changes of level in the Great Lakes and of smaller undulations in the atmospheric pressure by by means of a sensitive barograph, concludes that the larger differences are due to difference of atmospheric pressure over the extremities of the lake, but may be greatly augmented by the action of the wind on the surface of the water. The smaller undulations appear to be due to atmospheric waves caused by currents in different strata traveling in opposite directions, as shown by Helmholtz. Papers were also contributed by Rotch and Marvin 'On the Exploration of the Air by Kites,' showing how it was possible by means of recording instruments, sent up to great elevations attached to a kite to obtain information with regard to the temperature and hygrometric condition of the air, which would be of use in forecasting. It would appear, however, that there is still much to be done in improving the recording hygrometer.

In the department of mathematics there were several papers of esoteric interest. Alexander Macfarlane made an application of hyperbolic analysis to the solution of the cubic equation. Dr. Harris Hancock discussed the history of the Abelian Functions. Professor O. Henrici proposed a convenient notation in Vector Analysis, upon which it would be difficult to express an opinion without extended use by different workers and authorities in the subject. Professor Michelson and A. W. Stratton described some new Harmonic Analyses, in which they had succeeded in carrying the process as far as 80 terms. Papers were also contributed

by Major MacMahon on 'Partitions of Numbers;' by J. C. Glashan on the 'Quinquisection of the Cyclotomic Equation,' and by Dr. Larmor on 'Jacobi's Last Multiplier.'

On Tuesday the section divided along the lines of Electricity and General Physics, and many members regretted that they were unable to be present in both sections simultaneously. In the electrical department there were a number of papers on electrical waves and oscillations of different forms. Professor Braun showed how, by the action of a magnet on a small pencil of cathode rays directed on to a fluorescent screen, it was possible to demonstrate the form of the wave, either by developing the oscillating line of light into a curve with the aid of a revolving mirror or by using a second magnet to give the corresponding Lissajou figure. The frequency of the coil used was not, however, suitable to show the effects in a sufficiently clear manner to an audience. Professor Rosa exhibited an extremely ingenious mechanism for automatically plotting the form of an alternate current wave by the periodic contact method. At each point of the cycle the instantaneous difference of potential to be measured was found by shifting a contact point on a potentiometer wire till the galvanometer indicated a balance. On depressing a key the point so found was recorded on a cylinder, which was moved forward automatically in step with the periodic contact brush on releasing the key. By this means from twenty to thirty points could be recorded in a minute. The curves exhibited showed in a very remarkable manner small waves due to armature teeth and commutator segments, which could not be obtained with any slower method, owing to the necessarily limited number of points. Taking special precautions to secure very steady running of the machines, he had been able to analyze these curves with great accuracy as far as the fifteenth term of the harmonic series.

W. D. B. Duddell exhibited an instrument of a totally different character which could be applied to secure instantaneous photographs of the forms of these curves even under conditions of rapid change such as occur in studying the alternate current arc. He had succeeded in so reducing the period and adjusting the damping of a galvanometer with a pair of strips stretched between the poles of an electro-magnet and immersed in oil, on the plan suggested by Ayrton and Mather, that he was able to obtain very beautiful records of current and potential simultaneously at the ordinary rates of alteration on a falling plate. So far as could be judged from an inspection of the numerous specimens shown, the effect of inertia was practically eliminated. It would not, of course, be possible to measure the these curves with the same degree of accuracy as those obtained by the point-to-point method, but instantaneous photographs can be secured in cases where the slower method would be totally inapplicable.

After the reading of the Report of the Committee on Electrical Standards, to which reference has already been made, Professor J. V. Jones explained a method of calculating the coefficient of mutual induction of a circle and co-axial helix, by which the labor may be considerably shortened. This calculation is required in the Lorenz method of determining the ohm. Professor Ayrton next gave an account of the experiments in which he had been engaged with Professor Jones in redetermining the ohm by means of the Lorenz apparatus constructed for Professor Callendar, of McGill University. This apparatus has been made by Nalder Brothers, under the personal supervision of Professor Jones, and is considered to be the most perfect apparatus of its kind. The value found for

the ohm was nearly one part in 2,000 smaller than that usually accepted, but the uncertainty of the measurements was due rather to discrepancies in the comparisons of the standard coils than to want of consistency in the readings given by the instrument.

Professor Ayrton also communicated a paper by Mrs. Ayrton on the 'Relations between Arc Curves and Crater Ratios with Cored Positive Carbons,' which is being published elsewhere. Mrs. Ayrton is well-known as an authority on these subjects, but the paper is one which cannot be adequately explained without the curves by which it was illustrated. Papers were also contributed by Cerew and Basquin, 'On the Arc;' by Willard E. Case, on 'Gas Batteries,' and Professor J. C. MacGregor, on the 'State of Ionization of Solutions.'

In the department of general physics, there were a number of interesting papers on acoustics and on astronomical and magnetic observations, but the writer was unable to obtain any adequate abstracts or reports.

On Wednesday, Professor Ramsay read a paper on the refractivity of mixtures of gases. According to his observations, the refractivity of a mixture could not be deduced by the usual mixture formula. The discrepancy between theory and observation in the case of a mixture of hydrogen and helium amounted in some proportions to as much as 3%, with oxygen and nitrogen to 0.35%. These differences were systematic, and appeared to be too large to be due to observational errors. They indicate that the refractivity is not accurately proportional to the partial pressure, but that there is a deviation analogous to the deviations from Boyle's law, and apparently in a similar direction. It must be remembered, however, that the refractivity of helium is so phenomenally low as to make these measurements extremely difficult.

Professor O. Lodge introduced a discussion on 'Zeeman's Discovery of the Effects of Magnetism on Spectral Lines.' These effects have been recently described in a communication by Professor O. Lodge to the Royal Society of London, but it would appear from the discussion which took place in Section A, that the effects are so small even in the strongest fields, and are so difficult of study, that the physical explanation of the effect is still a matter of speculation.

Professor Ayrton communicated three papers by himself and J. Mather, on the use and sensibility of galvanometers, a subject upon which they are universally recognized as leading authorities. He explained the principle of the constant total current shunt, as applied to ballistic galvanometers, proposed a standard method of measuring the sensibility, and discussed the question of short versus long-period galvanometers for very sensitive zero-tests. He also exhibited a very simple and sensitive galvanometer of the D'Arsonval type, with a coil resistance of only 1.9 ohms, time of complete oscillation 7.5 secs., which gave a deflection of 36 millimetres at 2 metres for one microvolt.

A paper on the comparison of certain Thermocouples with the platinum resistance pyrometer was read by Mr. H. M. Tory, of McGill College. He showed that the parabolic formula could be regarded only as a rough approximation to the law of variation of the E.M.F. of a thermocouple. Using a platinum-rhodium couple enclosed in the same tube as the platinum pyrometer, he obtained very consistent results up to 1,000° C., showing deviations from the parabola of the same type as with the copper-iron couple at low temperatures. He showed that the assumption of a straight-line formula for the platinum-rhodium couple, which is often taken as sufficiently correct, may lead to errors of the order of 100° C.

Professor Callendar read a paper by himself and H. T. Barnes, of McGill College, on

'A Simple Modification of the B.O.T. Form of Standard Cell.' In this cell the usual construction is reversed, and the materials are introduced in the inverse order, namely, zinc amalgam, sulphate of zinc crystals, mercurous sulphate paste, platinum wire. The cell is portable and free from diffusion-lag, and is much easier to make and more convenient to use than the H-form. Owing to its shape, which permits of immersion in a water-bath, it is more suitable than the H-form for very accurate work, in which an exact knowledge of the temperature of the cell is required. The same construction is also applied with equal facility to the cadmium cell, but it appears that the latter cells are less consistent than the Clark cells at temperatures between 0° and 10° C.

There was a general consensus of opinion that the meeting had been as well up to the average in the quality and quantity of the work submitted, as it had been thoroughly enjoyable and successful from a social point of view. With so many communications to get through, it is to some extent inevitable that the discussions should be curtailed, but the authors of papers are themselves chiefly to blame in many cases if the discussion appears inadequate. It may be possible in future years to exact more stringently that the author should submit an intelligible abstract in advance, which might be obtainable at an early hour on the day on which the paper is read. In the few cases in which the printed abstracts are available they are frequently allowed to lie on the table, and were of no practical assistance to the discussion, as no one knew of their existence. It is to be hoped that the wide range of the work of Section A will not be allowed to detract from its usefulness, and that the committee appointed to consider the question will succeed in devising some scheme of departmental organization to mitigate the overcrowding of papers in future.

HUGH L. CALLENDAR.

THE BOTANY OF THE BRITISH ASSOCIATION.

THERE are few opportunities when it becomes possible for the botanists of America and Europe to exchange views and gain that personal knowledge of co-workers in which lies the real essence of acquaintance among scientific men, beyond those afforded by individual effort. It is true that a large number of American botanists have prosecuted more or less extended studies abroad, both in England and on the continent, and this number appears to be annually increasing. The majority, however, are denied such privileges, and for them it becomes a matter of first importance that occasions should arise when they are able to gain direct acquaintance with those who have been known to them in other ways for years. In 1884 the British Association for the Advancement of Science departed from its time-honored custom and held its first colonial meeting at Montreal. So rare an opportunity was eagerly taken advantage of by a large number of representative botanists from both sides of the Atlantic, and, although it was impossible at that time to fully measure the value of the results to be obtained, it was nevertheless felt that the work accomplished must be productive of great benefit, not only in a general advance of botanical science, but in a far better understanding between the botanists of Europe and America. The lapse of years has fully justified this view, and when it was announced that the British Association intended once more to visit Canada, after a period of thirteen years, the prospect was generally hailed with delight by American botanists, who would gladly see these opportunities for scientific conference become more frequent.

The sixty-seventh annual meeting of the British Association, recently closed at Toronto, will be remembered as a notable one in the history of botanical progress on this side of the Atlantic. The great ac-

tivity and interest which centered in the Botanical Section were largely due to the able and energetic manner in which the President conducted the work in hand. To the botanists of the United States, however, is also due no small credit for their share in this happy result. The determination had evidently been reached on their part to make the botanists of Great Britain feel that, although they were to be within their own domain during the progress of the meeting, there is a brotherhood in science which ignores all geographical and political limitations, and that on these grounds the most cordial sympathy and support should be extended. This was made evident not only in the very fortunate arrangement whereby the Botanical Society of America met at Toronto instead of at Buffalo, and concluded its proceedings as the work of the British Association began, but also in the fact that the majority of the botanists in attendance were Americans, and that a very large proportion—about one-half—of the papers presented were from the same source.

The Section met under the very able presidency of Professor H. Marshall Ward, of Cambridge, England, who was supported by Professor D. P. Penhallow, of McGill University; Dr. W. G. Farlow, of Harvard, and Professor F. O. Bower, of the University of Glasgow, as Vice-Presidents. The attendance was not large, although representative. Of English botanists only eight were present, including, in addition to those already named, Mr. A. C. Seward, of Cambridge; Professor F. Weiss, of Owens College, Manchester; Professor J. B. Farmer, of the Royal College of Science, London; Mr. Harold Wager, of Leeds, and Professor J. R. Green and Miss D. F. M. Berts, of Cambridge.

Among those representing American botany were noted: Dr. W. G. Farlow, Dr. Britton, Dr. Coulter, Professor Barnes, Professor Penhallow, Dr. Galloway, Dr. T. J. W. Burgess, Dr. Bessey, Dr. Arthur, Mr. Webber, Professor Green, Mr. Jeffrey and others. Exceptional interest was added to the proceedings by the presence of Professor P. Magnus, of Berlin, who also contributed a valuable paper 'On the Mycelium of a Witches' Broom Fungus' and otherwise assisted in the work of the Section.

There were twenty-one papers in all presented to the Section, representing original research in nearly all the numerous branches of botanical science. These contributions were, in most cases, of a notable character, and drew forth animated and valuable discussions. The report submitted by Professor Farmer, respecting certain investigations on the 'Fertilization of the Phæophyceæ' conducted under his supervision, already indicates that new and important facts bearing upon the relationships of this group have been obtained. The investigations continue for another year under a renewed grant from the British Association.

Mr. Harold Wager gave an account of some recent studies of the yeast plant and other species of Saccharomyces, with respect to the presence of a nucleus and its constitution in various stages of development. The nucleus in yeast has been a subject of study for the past six or eight years, and its presence, as demonstrated by some seventeen observers, is abundantly confirmed by the results obtained by Mr. Wager. The author has not been able to reach final conclusions respecting the question which has been for some time in controversy as to whether the nucleus possesses a nucleolus or not, but his researches tend to the belief that certain granular bodies in constant association with the nucleus, and which present very different conditions of aggregation at various stages of growth, may represent the nucleolus. It was further shown that, in the process of budding

the nucleus extends into the neck, where it undergoes direct division, one-half remaining in the mother cell, while the other half enters the bud; and that, in the process of spore formation, the nucleus breaks up into two, and then into four, nuclei by a very simple process of karyokinesis. Some of the phenomena observed appeared to be new in the history of nuclear division and require more extended observation, but the paper as a whole offered an important addition to our knowledge of cell life, and proved to be particularly opportune in connection with the joint discussion on the cell held by the botanists and zoologists.

The efforts originally made by Hartig, and later by Brefeld, to study the development and action of wood-destroying fungi as represented by *Stereum hirsutum*, met with failure either through lack of pure cultures or imperfect methods of treatment. Professor Ward presented an account of his own recent studies of this plant, in which he employed blocks of sterilized wood, whereby he succeeded in securing a perfect fructification and observing the plant in all stages of development. The details of the progressive destruction of the woody tissue were also dealt with, and it was shown that the lignified structure gradually yielded to the action of the fungus and passed into the condition of cellulose-like bodies, giving the characteristic iodine reaction, before final consumption. The paper was illustrated by a series of beautifully prepared lantern slides, from photographs and drawings.

Professor Penhallow contributes the results of recent studies of the species of *Picea* occurring in the eastern United States and Canada, in the course of which he showed that the red spruce which had been abandoned as a distinct species since the time of Pursh, and regarded as a form of the black spruce, must once more be restored to the status of a valid species as maintained by Lawson and later by Britton. He also pointed out that there is a well defined variety of the white spruce, hitherto unrecognized, the chief characteristics of which are to be found in the strongly glaucous, rigid, often broad and cuspidate leaves, and distinctly fetid odor which has long led lumbermen and others to designate it by the name of 'Cat' or 'Skunk Spruce.' He proposes to distinguish it by the variety name of *fœtida*.

Mr. Francis Darwin gave a preliminary account of a new method of investigating the behavior of stomata, in which he details the use of a new form of hygroscope made of thin sheets of specially treated horn or 'Chinese sensitive leaf.' One end of a narrow strip is secured to the lower surface of a block of cork, and the angle to which the free end rises becomes the index of transpiration. In application, if the leaf have stomata on the under surface only, the index of the hygroscope applied to the upper side remains at zero, while on the lower side it instantly rises to an angle varying with the condition of the stomata. If these organs are widely open, the angle will be 30°–40° to a horizontal line; if the stomata are closed, the reading will be zero on both surfaces of the leaf. With this instrument a number of well known facts in the physiology of the stomata can be easily demonstrated.

Mr. H. J. Webber, of the U. S. Department of Agriculture, detailed the results of recent studies on the spermatozoids of *Zamia*. By means of a series of beautifully prepared sections he demonstrated the occurrence of unusually large spermatozoids, which, together with their flagellæ, may be seen without difficulty with an ordinary pocket lens. The paper throws new light upon our conception of the sexual elements of the Gymnosperms, and will doubtless serve as a powerful incentive to greater activity in the study of this group of plants.

Among other notable features of the meeting were a joint discussion, together with the zoologists, on the Cell; a public lecture on Fossil Plants by Mr. A. C. Seward, who, since the death of Williamson, has been recognized as the leading paleobotanist in Great Britain; and joint action with the Sections of Zoology and Physiology for the establishment of a biological station in the Gulf of St. Lawrence. While it is intended that such a station shall be primarily designed for economic ends in connection with the fisheries, it is hoped that opportunities may be offered for a limited number of students to pursue special investigations relative to both animal and plant life, and thus to supplement the work of larger stations, such as that at Woods Holl.

The special interest of the Section centered in the presidential address, which dealt in a very masterly manner with the progress of botanical science during the latter half of the Victorian reign. The address was a very noteworthy one from several points of view, though chiefly as an important historical summary. While it would be difficult and altogether unsatisfactory to attempt an abstract of a paper so rich in facts, it may be pointed out that it gave the strongest evidence to show the great dependence of important commercial undertakings and economic processes upon data derived from modern scientific botany, as also the very close relations which exist between chemistry and botany as now known. The address will form a useful key to a much wider literature, and deserves the careful perusal of the specialist as well as the general morphologist.

D. P. P.

MARINE BIOLOGICAL LABORATORY.

A STATEMENT TO THE CORPORATION FROM THE TRUSTEES.

THE annual meetings of the Corporation will hereafter be held at Woods Holl in August instead of at Boston in November, and absent members can now vote by proxy. The Board of Trustees has been enlarged to twenty-seven members, and the new Board, it is believed, fairly represents nearly all sections of this country and Canada. The closer cooperation of all institutions of learning is actively encouraged.

These changes will make possible the attendance of a large number of members, at annual and special meetings, who have been unable to reach Boston during the month of November, and there are already signs of increasing interest in the institution over a much wider area. The members will be glad to learn that, at the recent meeting of the British Association in Toronto, Dr. Dohrn, head of the unrivalled station at Naples, took occasion to speak as from personal knowledge in terms of warm commendation of the work at Woods Holl. The past summer has been highly satisfactory; but the Trustees have been hampered by lack of funds for needed repairs and renewals, and, to some extent, for current expenses. At least $1,000 should be raised before resuming work next summer, and there remains a debt of about $4,700 incurred for the erection of new buildings. This debt should be cancelled in order that a clear balance sheet may be shown before undertaking several most desirable extensions of the plant, some of which are urgently needed. Salaries should be increased, and greater inducements offered to the strong corps of instructors and workers whose collaboration has enabled the institution to attain its present position in the scientific world. Moreover, there is no assurance of permanence in an institution of this nature until it shall have acquired a sufficient endowment or maintenance fund, independent of its land, buildings and equipment (which now represent an investment of over $33,000), to relieve it from danger of extinction by one or more sea-

sons of small attendance. The Endowment Fund now amounts to over $3,500 and has been carefully husbanded, but it should be increased to at least $50,000. And the special funds, the Lucretia Crocker Fund for Scholarships and the Library Fund, may profitably be added to.

One effect of the recent changes in the By-laws will be, or may be, to diminish the special interest in and sense of responsibility for the Laboratory heretofore shown in the city of Boston and its immediate vicinity, to which, as is well known, the institution owes its initial impulse and much continuous and generous support. In appealing, as they do now, to a wider constituency, the Trustees are in no wise unmindful of the debt which the cause of science and of sound learning owes to this intelligent and kindly support in the past, some of which support, as they are assured, will hereafter be extended, with unwearied generosity, from the same locality. The Laboratory now looks to the country at large for its main sources of income and upon all the corporate members, in whose hands the recent changes have placed the entire control, rests the correlative duty of supporting the work. With power comes responsibility.

The Trustees, therefore, have decided to raise the annual dues of members of the Corporation to two dollars ($2.00). The fiscal year now begins on the second Tuesday in August, and this sum is due for the year ending August 9, 1898. Members of the Corporation will kindly forward it, together with all back dues, to the Treasurer, D. Blakeley Hoar, 220 Devonshire St., Boston, Mass.

For the reasons given above, the Trustees also appeal to the members of the Corporation to send with their annual dues such further sums, however small, as the means and interest of each in the work may inspire. All contributions will be duly noted in the annual report which is in course of preparation and will be issued early in the coming year. A contribution of not less than $100 entitles the donor to a life membership, exempt from annual dues, or, at his option, to nominate a person to occupy a private room in the Laboratory, free of charge, during one season. A contribution of $50 entitles the donor to a free scholarship, exempt from tuition fees, during one season. Contributions of smaller amounts will be gratefully received and duly acknowledged.

The forthcoming report will show fully all the recent changes in the organic law of the Association, and will be sent to all members in good standing.

By order of the Trustees,

HENRY F. OSBORN, *President*,
H. C. BUMPUS, *Secretary*,
D. BLAKELEY HOAR, *Treasurer*,
C. O. WHITMAN, *Director*.
EDWARD G. GARDINER, *Chairman of Executive Committee*,
JAMES I. PECK, *Assistant Director, Executive Committee*,
CAMILLUS G. KIDDER, *Executive Committee*.

All matters relating to scientific administration should be addressed to Professor C. O. Whitman, University of Chicago, Chicago, Ill. All applications for membership, to the Secretary, Professor H. C. Bumpus, Brown University, Providence, R. I. All dues and subscriptions, to the Treasurer, D. Blakeley Hoar, 220 Devonshire St., Boston, Mass.

A NEW LABORATORY DISH.

IN the laboratory of the college we use for routine work the paraffin method almost exclusively. The blocks of tissue are infiltrated in the usual manner, and the sections cut with the Ryder or Minot microtome. The student cuts his sections and fastens them on to the slide by means of Ole-

macher's combined water albumen method, a combination, with certain improvements, of the methods of Gaule and Mayer. These are then placed in the drying oven at a temperature of 37° C. for from 12 to 24 hours, until all the water is evaporated, the paraffin and section having, during the evaporation of the water, straightened out perfectly. The slide is now gently warmed until the paraffin, which has a melting point of 45° C., begins to melt, when it is thrust into kerosene, which in ten minutes completes the removal of the paraffin. The excess of kerosene is wiped off, the slide washed with a few drops of alcohol and then placed in a dish of alcohol; from this dish of alcohol the stain is proceeded with as usual. If the tissue has been hardened in corrosive sublimate it is necessary to carry the cemented section through diluted tincture of iodine to remove the mercurial salt; this is followed by washing in alcohol when the section is ready for staining. The stains are conveniently kept in large salt-mouthed bottles into which the slides are placed for staining, mordanting, dehydrating and clearing. It is usual for the student to take from 5 to 10 slides through the various solutions, at one time, and, in so doing, he not uncommonly scratches the section off of one slide by rubbing it against another. This difficulty arises, no matter whether the method of Gaule, Suchannek's modification of Gaule's method, Gulland's modification of Gaule's method, or, what is better, Heidenhain's water method, be used. Even using any of the collodion methods does not permit us to escape this danger. In order to overcome this, the writer sought very carefully through the dishes which have been designed by various workers, but failed to find anything which was ideally available. True, Ranvier has designed a rack upon which a number of slides may be supported, but this is entirely too cumbersome for general laboratory use, and besides involves a large amount of fluid, which makes it an expensive luxury. With these points in view, I have devised a dish which is expected to overcome some of the above difficulties.

The inside measurements of the dish are $3\frac{1}{2}$ inches in height, 1 inch square at the bottom, $1\frac{3}{8}$ inches square—three inches from the bottom, and $1\frac{3}{4}$ inches in diameter at the top, which is round and closed by means of a ground, grooved, Stender cover, which, of course, fits air-tight. In order to render the dish stable, the base is the broadest and heaviest part, measuring nearly $2\frac{1}{2}$ inches in diameter. Extending upward from the bottom of the inside of the dish, on two opposite sides, are eight ribs, four on each side, forming between them three grooves sufficiently wide to admit, in each groove, two slides of ordinary thickness. There can, also, be placed in the outside groove, between the outside ribs on each side and the inside of the dish two slides. This gives the dish, for ordinary purposes, convenient and not crowded, accommodation for eight slides standing on end; or, if the sections be not large and the slides not thick, four slides may be placed outside of the ribs, two on each side back to back.

An ordinary Stender dish requires about 120 cc. of fluid to immerse a slide sufficiently to cover a section cemented to its center. The above dish requires less than $\frac{1}{3}$ of that amount to secure an equivalent degree of immersion. Of course, these dishes vary slightly in their capacity, as all pressed glassware does; such a variation, however, does not amount to more than from 10 to 15 cc.

Where, for reasons of economy, or otherwise, it may be desirable to close the top of the dish by means of a cork or rubber stopper, the expense may be materially reduced. When closed by means of a glass cover, as described above, and shown in the

illustration, the cover and the dish will each bear the same number cut in glass, so that the student, working at his desk, may easily avoid mixing the covers which would not only be detrimental by mixing incompatible fluids; but, as each lid can be ground only to fit the dish which accompanies it, exchanged lids will not fit tightly.

In order to facilitate cleaning and to avoid inaccessible corners, all the corners are rounded.

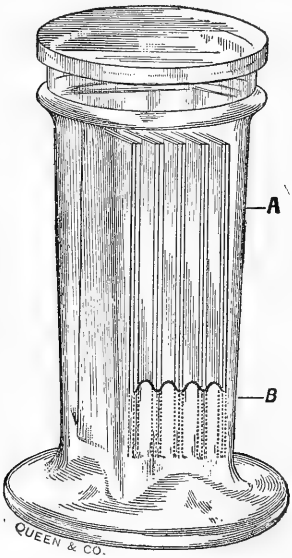

FIG. 1.—This cut is about $\frac{2}{3}$ of the exact size of the dish. At A can be seen ten (10) slides, placed back to back and passing down between the ribs at B. Since this figure was drawn the width of the base has been increased, so that the base is now the width as shown in Fig. 2.

The advantages claimed for the dish are: (1) Convenience, in that a number of slides can be safely handled at one time. (2) Great economy in the reagents; not only is the amount used less than is required by the use of Stender dishes, but in case, as will not uncommonly happen with students, anything occurs which ruins the contained fluid the loss may be materially less. (3) Solidity: no other dish of the same height and the same capacity possess the same solidity. (4) Contained fluids are prevented from evaporating by the tight-fitting top. This is not secured in the Naples dish.

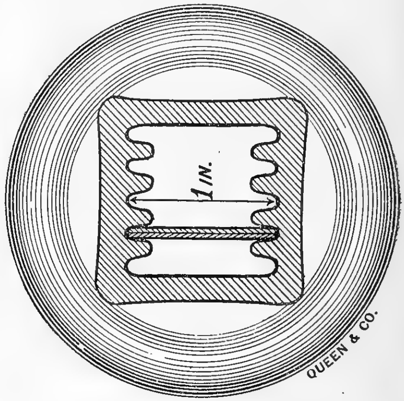

FIG. 2.—This represents a transverse section of the dish at the point marked B in Fig. 1. In this view we are looking down into the dish from above; the ribs and the intervening grooves are shown. The two arrows mark the position in which the ribs are lying and the two points, between which it is exactly 1 inch. Just to the left of the arrow is shown a transverse section of two slides placed back to back, as is usually done for staining.

I desire to express my appreciation of the help given me by Messrs. Queen & Co. in securing working drawings from which the above cuts have been made.

W. M. L. COPLIN.
JEFFERSON MEDICAL COLLEGE.

NOTES ON INORGANIC CHEMISTRY.

THE address of Professor William Ramsay, President of the Chemical Section of the British Association at Toronto, was out of the usual order. It was entitled 'An

undiscovered gas,' and narrated a search for an element with the atomic weight of 20, lying in the periodic system between helium and argon. Many 'triads' are found in the periodic system, with a difference in atomic weight of about 36 between the extremes, viz.: fluorin, chlorin, manganese, 19–55; oxygen, sulfur, chromium, 16–52; nitrogen, phosphorus, vanadium, 14–51.4, etc. If argon has an atomic weight of 40 and helium of 4 there might be expected a triad here, with a middle element of atomic weight about 20. Professor Ramsay and his assistant, Mr. Travers, made a diligent search for this element, which would, like argon and helium, probably be an indifferent gas. The gases from various minerals and mineral springs were carefully examined in vain. Helium was then fractioned by diffusion through porous plates. After 180 diffusions two fractions were obtained, the larger portion having a constant density of 1.98, that is pure helium, while the smaller portion had a variable density, and was finally proved to be helium with a small portion of argon. This search also proved fruitless. The non-existence of the gas is, however, not proven; helium itself in fergusonite, one of the minerals which yields it in reasonable quantity, is present only to the extent of 33 parts in 100,000, and if the new gas, as is by no means improbable, occurs far less abundantly than helium it will be a work of extreme difficulty to separate it from helium or argon.

IN the last *Chemical News*, G. G. Boucher describes a possible new element in cast-iron. He has found it to the extent of a few thousandths per cent. in the residues left after dissolving iron in sulfuric acid. The metal seems to possess some of the reactions of tungsten and of antimony, but has not yet been identified with any known element.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

MEETING OF THE TRUSTEES OF THE MARINE BIOLOGICAL LABORATORY.

A MEETING of the Trustees was held at Woods Holl, Mass., upon Friday, September 10th. Thirteen members of the Board were present, including the Director, Professor Whitman; Professor Clarke, of Williams; Professor Macfarlane, of Pennsylvania; Professor Osborn, of Columbia; Mr. E. G. Gardiner, of Boston; Professor Bumpus, of Brown; Professor Penhallow, of McGill; Professor Metcalf, of Baltimore; Professor Patten, of Dartmouth; Professor Conklin, of Pennsylvania; Professor Morgan, of Bryn Mawr; Professor Peck, of Williams; and Mr. C. G. Kidder, of New York. The first business was the election of a President in place of Professor Farlow, of Harvard, resigned, and Professor Osborn, of Columbia, was chosen by ballot. Mr. D. Blakeley Hoar, of Boston, was elected Treasurer in place of Mr. Laurence Minot, resigned, and a resolution was passed gratefully acknowledging Mr. Minot's long and generous services to the Laboratory during the past four years. Professor Bumpus, clerk of the corporation, was elected Secretary. According to the new By-Laws, the business of the Trustees will be largely transacted by an Executive Committee, which consists of the principal officers of the Association and three members at large. This Committee was constituted for the coming year as follows: at large, Messrs. Gardiner, Peck and Kidder; and *ex officio*, Messrs. Osborn, Whitman, Bumpus and Hoar. The powers of the Executive Committee were carefully defined and limited, and this Committee was instructed to keep formal record of all its business and report to the Trustees at each meeting. A very full report of the financial condition of the Laboratory was received from the retiring Treasurer, Mr. Laurence Minot, and presented, with an analysis of the receipts and expenditures of the last season, by Mr. Kidder. It was shown that the Laboratory is practically self-supporting, but that the interest and other general charges cause an annual deficiency, which must be met by special subscription. The report of the Director was deferred until the next meeting of the Board. Two important Committees were chosen,

namely, upon Collegiate Cooperation as follows: Professor Libbey, of Princeton, Chairman; Professors Whitman, Macfarlane, Penhallow, Gardiner, Mall and Osborn; also a Committee upon Admission to Membership in the corporation, Professor T. H. Morgan, of Bryn Mawr, Chairman; Dr. E. G. Conklin, Dr. J. P. McMurrich, Dr. W. F. Ganong, Dr. E. G. Gardiner and Miss Katharine Foot. It was decided to hold the next full meeting of the Board at Ithaca, during the meeting of the American Society of Naturalists in December, and to issue the annual report immediately thereafter.

THE JOHNS HOPKINS BIOLOGICAL STATION IN JAMAICA.

WE have received from Mr. J. E. Duerdon, curator of the Jamaica Institute at Kingston, some notes regarding the researches undertaken this summer at the Marine Laboratory at Port Antonio under the charge of Professor J. E. Humphrey, whose sad death we were recently compelled to record. The party, twelve in number, secured two well-lighted rooms in the Titchfield Hotel of the Boston fruit company for a laboratory which afforded accommodation for eight tables, the necessary apparatus and reagents being brought from the University Laboratory. From the shallow waters around the harbor collections have been made in most of the various groups of animals, while the land has also been scoured for representatives of the fauna and flora. It was not found possible to carry on much dredging. In the facilities for collecting and in the richness of forms met with, the locality has been shown to surpass Port Henderson in many ways; though, owing to the continuous absence of a smooth sea about the margin of the coral reefs, Port Antonio compares unfavorably for reef work with the conditions to be met with, for some hours each morning, at the Port Royal Cays near Port Henderson.

Professor Humphrey was giving special attention to the shell-perforating algæ or sea-weeds and to the embryology of certain groups of the flowering plants, particularly among the latter to those of the pepper and ginger families. Dr. F. S. Conant continued investigations begun by him last summer upon the *Cubo-medusæ*, a rare group of jelly-fish of which two species have been found in extraordinary abundance in Jamaican waters. The chief object of investigation this season has been the function of the sensory organs of the jelly-fish, and material has been prepared with especial reference to a study of the changes, under the influence of light and darkness, in the pigment or coloring matter of the retina of the eyes. Dr. H. L. Clark has been engaged in a continuation of the work which he also began last summer on the Echinoderms (star-fish, sea-eggs, sand-dollars, sea-cucumbers, etc.), of the island, giving especial attention to the Holothurians or 'sea-cucumbers,' forms of life which are very abundant around Jamaica. Over fifty species of the group of the Echinoderms have now been collected by him and other workers, some of which are possibly new to science. Mr. Sudler has been studying the life history of *Lucifer*, one of the small crustaceæ; Mr. Greve, Ophiurius, or sea stars, and Mr. Berger, especially pseudo-scorpions. Collections have been made by Mr. A. Fredholm, of the Smithsonian Institution, Mr. Wilson and others. Mr. Duerdon was allowed the facilities of the laboratory and made a study of the Actiniaria.

THE CONFERENCE ON THE SEAL FISHERIES.

THE British Foreign Office has issued a blue book of 130 pages containing the correspondence with the United States government respecting the seal fisheries in Behring Sea. Lord Salisbury, replying to Secretary Sherman's despatch of May 10th, sent a short note to Ambassador Hay on July 28th. We reproduce this note, as it shows that the conference in Washington is intended to be strictly scientific in character.

"I have to state that her Majesty's Government are willing to agree to a meeting of experts, nominated by Great Britain, Canada and the United States, in October next, when further investigations to be made on the islands during the present season will have been completed.

"The object of the meeting would be to arrive at correct conclusions respecting the numbers, condition and habits of the seals frequenting the Pribylov Islands at the present time, as compared with several seasons previous and subsequent to the Paris award.

"It seems to her Majesty's Government that Washington would be the most suitable place for such meeting.

"The other portions of Mr. Sherman's despatch, in so far as they require any reply from her Majesty's Government, have been answered by anticipation in despatches which I addressed to her Majesty's Ambassador at Washington on April 2 and May 7 last, and which have been communicated to the Government of the United States."

Russia and Japan have signified their intention of being represented at the conference on the invitation of the United States. The United States will be represented by ex-Secretary John W. Foster and ex-Assistant Secretary Charles S. Hamlin. It has been arranged that President Jordan, of Stanford University, and his assistants, as well as the British scientific experts, shall appear personally before the conference to give the results of their investigations.

GENERAL.

THE Tenth Annual Winter Meeting of the Geological Society of America will be held at McGill University, in the city of Montreal, on December, 29, 30, 31, 1897. Details of the meeting will be announced in a circular to be issued by the Secretary, Professor Herman LeRoy Fairchild, about November 1st.

THE Berlin Academy of Sciences has made an appropriation of 3,000 Marks to Professor B. Hagen, Frankfurt, for the publication of an anthropological atlas; one of 1,500 Marks to Professor Kohen, Greifswald, for mineralogical researches, and one of 800 Marks to Professor R. Bonnet, Greifswald, for anatomical researches.

THE Dutch Academy of Sciences at Harlem has proposed seventeen subjects for papers to be presented before the beginning of next year. A gold medal is offered in each subject, or, in its place, 500 florins, with an addition of a further 500 florins in special cases. The essays may be in English. The details may be secured from the Secretary of the Academy, Professor Bosscha, Harlem.

LORD KELVIN has returned to New York from the Pacific coast and is at present the guest of Mr. John Bottomley, at Southampton, L. I. He proposes to make another short visit to Canada, and after visiting Mr. Westinghouse at Lennox will return to Great Britain.

WE learn from *Natural Science* that Dr. Henry Woodward, keeper of the department of geology in the British Museum (Natural History), has been permitted by the Treasury to retain his office for another two years. According to the rules of retirement in the civil service, his term of service would have expired next November.

MR. PERCY EMARY has been elected Secretary of the Geologists' Association, of London.

MR. HENRY W. SAGE, President of the Board of Trustees, of Cornell University, died at Ithaca, on the night of September 17th, at the age of eight-three years. Mr. Sage had given more than one million dollars to Cornell University and had been a generous donor to other educational and public institutions.

WE regret to record the death, in Assam, on July 29th, of Samuel Edward Beal, at the age of sixty-two years. He had made contributions to a wide range of sciences, including geography, astronomy, philology and agriculture.

SIR EVERETT MILLAIS, the author of numerous publications on scientific dog-breeding, and at one time editor of the *Stockkeeper*, died at Shepperton, on Tuesday, 7th. Sir Everett introduced into England the Basset hounds whose pedigrees Dr. Galton recently used for his important study on heredity.

MR. R. T. GUNTHER has gone to Lake Urumiya, on the Persian frontier, with a view to studying the fauna of the lake.

THE extensive collections of fossils made by Mr. F. E. Gurley, Danville, Ill., formerly State Geologist, is offered for sale.

THERE has just been added to the Philadelphia Museums a laboratory of tests and technology for the examination and analysis of raw and manufactured products.

COL. YOUNG, United States Army, acting Superintendent of the Yellowstone Park, has made a report to the Secretary of the Interior, stating that black bears and coyotes have multiplied so rapidly in the Park as to become annoying, and recommends capturing some of the bears for zoological gardens and killing some of the coyotes. He states that some of the people

living near the Park object to the protection of wild animals in their vicinity.

Mr. J. G. Jack opened, on September 18th, a course of lectures at the Bussey Institution, Arnold Aboretum. The lectures are popular in character and are followed by field meetings in the Aboretum. Subsequent lectures will be given on the following subjects: September 22d, maples and cherries; September 29th, thorns, locusts and hollies; October 2d, ashes and sumachs; October 6th, walnuts and hickories; October 9th, cornels and viburnums; October 13th, elms; October 16th, oaks.

The September number of the *American Naturalist* is the first to be edited by Dr. Robert P. Bigelow, of Boston, assisted by an Editorial Board, the names of whose members are not given, and a number of associate editors. To these have been added since the last issue of the journal, Messrs. G. Baur, C. E. Beecher, D. H. Campbell, J. H. Comstock, W. M. Davis, D. S. Jordan, C. Palache, H. M. Richards, W. E. Ritter, F. Russell, W. Trelease, S. Watasé. The strong hand of Professor Cope will be greatly missed in the *Naturalist* as elsewhere, but the continued usefulness of the journal appears to be assured under its new management. There is undoubtedly room in America for a monthly journal devoted to the natural sciences, in addition to the special journals devoted to a single science. With the *American Journal of Science* occupied more especially with the physical and geological sciences, the *American Naturalist* for the natural sciences and special journals for each of the sciences, America is admirably provided with the means of publication so essential for the advancement of science.

We quoted recently an editorial article from the *Journal of Geology*, on the debasement of the Missouri Geological Survey. The current number of the *American Geologist* also contains an editorial on the subject, from which it appears that Governor Stevens appointed a board consisting of political workers of the lowest type, Professor E. M. Shepard, of Drury College, Springfield, the only scientific member of the board, having resigned, and that the State Geologist appointed by them has no scientific qualifications of any sort. The records and cabinets of the Survey, which have been accumulating for the past eight years, under the present law have been consigned to the attic of an old building; all field work has been abandoned and several pieces of work, almost ready for publication, have been thrown aside. The work of the Survey at present appears to consist of drawing the usual salaries from the State Treasury. We believe that public sentiment, when expressed, is sufficient to prevent the subversion of science and education to politics, but it is often difficult to secure the expression of this sentiment, especially in cases which appear to be local in character.

From the *Sydney Morning Herald*, *Natural Science* condenses the following information regarding the second expedition to make deep borings into the coral atoll of Funafuti, which set sail from Sydney on June 3rd: Toward the expense of the expedition, Miss Eadith Walker, of Yaralla, has contributed £500; the government of New South Wales has lent a diamond drill; the Hon. Ralph Abercromby has furnished an oil-engine at a cost of £100; the Hon. H. C. Dangar and Professor T. P. Anderson Stuart have provided a fine boat; the Royal Society, London, contributes £100 directly, and probably another £100 through its coral-boring committee; finally, the London Missionary Society has offered to bring the party back to Sydney in September. The expedition is under the auspices of the Royal Geographical Society of Australasia, and its leader is Professor T. W. E. David, of Sydney. He and Mr. G. Sweet, of Melbourne, are going at their own expense, and will take charge of the borings. Mrs. David accompanies them as store-keeper and botanical collector. Mr. W. Poole, an engineer of Sydney University, will manage the light boring apparatus, and will be aided by Mr. Woolnough, who also takes charge of the zoological collecting. These gentlemen give their services free. The large diamond drill is in charge of Mr. Hall, a foreman of considerable experience, who has under him two sub-foremen and three drill-workmen. In view of the difficulties already met with at Funafuti, a special boring plant has been provided under the direction of Chief-Inspector W. H. J. Slee, and weighs over 25 tons. The main bore, on the

central island of Funafuti, will be begun with a standpipe having an inside diameter of 6 inches, and the lining pipe at first is to be 5 inches inside diameter. If, at two or three hundred feet, the friction should become too great, 4-inch pipes will be lowered inside these. It is thought that the foundations of the atoll will be reached between 200 and 500 feet, but the apparatus taken permits of a depth of 1,000 feet being reached. The core obtained will be forwarded first to the Royal Society of London, which will return one-half to the Royal Geographical Society of Australasia. The expedition will also make smaller borings on the sand cay in the middle of the lagoon, will conduct dredging operations for Sydney University and the Australian Museum, and will collect samples of sea-water for Professor Liversidge to examine for gold.

THE Philadelphia Normal School has this year established a psychological laboratory equipped for studying the senses and mental processes. Ten years ago there were only two psychological laboratories in America; at present they form an integral part of nearly all our universities and larger colleges. Their extension to normal schools is a forward step of importance in educational methods.

PSYCHOLOGICAL laboratories will probably also be established soon in hospitals for the insane, in asylums for the defective classes and in prisons. A beginning has been made in several places, but the first well equipped laboratory is now being established in the Illinois Eastern Hospital, under the direction of Dr. William O. Krohn, lately professor of psychology in the University of Illinois. A laboratory of this character will be of great practical value to the patients in the asylum, and may also be expected to make valuable contributions to psychology. As an organ for the publication of its scientific work, the Illinois hospital is about to establish a laboratory bulletin, which will appear at least four times a year. Subscriptions, $2.00, may be sent to the Hospital at Hospital, Ill.

AMONG papers announced to be read at the next meeting of the Australasian Association for the Advancement of Science at Sydney next Christmas are the following: 'The Classification of Eucalypts,' by J. G. Luckman; 'A Statistical Account of Australian Fungi,' by D. M'Alpine; 'The Algæ of Victoria,' by H. T. Tisdell; 'Flowers of the Order Proteaceæ,' by J. Shirley; 'Underground Fungi of Tasmania,' by L. Rodway; 'Australian Oceanography,' by T. W. Fowler; 'On the Formation and Structure of Coral Reefs,' by J. J. Wild; 'The Dialectic Changes of the Indo-Polynesians,' by the Rev. S. Ella; 'The Oceanic Peoples,' by E. Tregair; 'The Ancient Geography of the Maoris' and the 'Geographical Knowledge of the Polynesians,' by S. Percy Smith; 'The Mythology of the Efotese,' by the Rev. Dr. Macdonald; 'Old Samoa' and 'Australian Cave Paintings,' by the Rev. J. B. Stair; 'The Pankuma Natives,' by the Rev. F. J. Paton; 'Notes from Ambrom,' by the Rev. Dr. Lamb; 'The Tongans' and 'The Tongan Language,' by the Rev. J. E. Moulton; 'Ancient Maori Rites and Customs,' by Mr. Elsdon Best; 'The Food of the Ancient Maoris,' by the Rev. J. G. Hammond; 'Anthropometric Data, taken from School Children at Randwick,' by Jas. A. Dick; 'The Characteristics of Australian and other Diamonds,' by E. W. Streeter. The sub-committee of the council appointed to consider the matter of excursions, entertainments, visits to works, etc., has not yet completed its arrangements, but a harbor excursion had been decided upon, and two popular lectures, with possibly a third one, for workingmen, also a concert, at the University, and a conversazione by the Royal Society.

AN International Congress against alcoholism met at Brussels from August 30th to September 3d. It was under the patronage of King Leopold, and was presided over by the Minister of Agriculture.

THE sixth session of the International Institute of Statistics was opened at St. Petersburg by the Grand Duke on August 30th, holding its sessions simultaneously with those of the International Geological Congress. Numerous papers were presented dealing with military anthropometry, criminal statistics, the production of the precious metals, agricultural products, etc. Dr. Körösey, director of the statis-

tical bureau at Buda-Pesth, presented a plan for a simultaneous census of the population of the world in 1900.

THE steamship *Hope*, with Lieutenant Peary and the several scientific parties who accompanied him, arrived at Sydney, C. B., on September 20th. Lieutenant Peary has secured the large Cape York Meteorite destined for the American Museum of Natural History.

A PROPOSITION has been made for the establishment of an agricultural experiment station in Madagascar for the introduction of foreign plans of economic value and the study of those native to the island.

IT is stated in *Nature* that Mr. C. Michie-Smith, the Government Astronomer at Madras, in his reports for the year ending March 31st, says that, as regards the staff, the government has sanctioned the revival of the appointment of a chief assistant. The past year has been conspicuous by the great amount of heavy rain, and both the director's and assistants' houses have suffered considerably. Observations for time have, as usual, been carried on, and the investigation for the determination of the divisions error of the Meridian Circle has been completed, no less than 72,192 micrometer readings being employed. The Madras Catalogue has further advanced, and the mean places for the first sixteen hours have been deduced. Proposals have been sanctioned for observing the total eclipse of the sun next January, and Karad has been fixed upon as the most suitable station.

IN an address on 'Medical Botany,' presented before the Section of Materia Medica, at the recent meeting of the American Medical Association, and printed in the Journal of the Association, Professor Trelease states that while botany is still taught, to a certain extent, in medical colleges and schools of pharmacy, an analysis of the appropriateness of this study in the curriculum of either school has led him to the conclusion that for the physician it is to be regarded as an accomplishment rather than a necessity, inasmuch as in the medical practice of to-day prepared drugs and fluid extracts are prescribed, rather than the crude material, which in any event rarely comes under the physician's own observation, his knowledge dealing with the physiological rather than the physical properties of the remedial agents employed by him. While the pharmacist still has some occasion for discriminating between crude drugs, Professor Trelease concludes that even for him the botanical knowledge required is rather that of pharmacognosy than of botany in the ordinary sense; and the opinion is expressed that a knowledge of medical botany, in the old sense, is to-day essential rather to the expert of the manufacturing house than to either the physician or the pharmacist. Attention, however, is called to that branch of medical botany which has recently come into nearly all of the better equipped medical schools, dealing with the bacteria of disease, although even here it is argued that the study is rather for the expert than for the everyday practicing physician.

THE committee of the British Association appointed to report on the elucidation of the life conditions of the oyster under normal and abnormal environment, including the effect of sewage matters and pathogenic organisms, presented at Toronto a report on the green disease, drawn up by Professor Herdman and Professor Boyce. They conclude by stating that there can by no doubt that Ryder, in America, about 1880, investigated the same kind of green oyster with which they are dealing. He showed that the green coloring matter was taken up by the amœboid blood-cells, and that these wandering cells containing the pigment were to be found in the heart, in some of the blood-vessels and in aggregations in 'cysts' under the surface epithelium of the body. He describes the color (in the ventricle) as a 'delicate pea-green,' and states that it is not chlorophyll nor diatomine; he suggests that it may be phycocyanin or some allied substance. The committee have now shown that it is due to a copper compound, and consider that Ryder came nearer to what they now consider to be the truth than any previous investigator has done. He was trying to show that the color was derived from the food. Carazzi has recently suggested that the color (this, it must be remembered, is in the Marennes oyster), due to iron, is derived from the bottom on which the oyster is lying. The committee have tried numerous experiments in feeding oysters on iron and

copper salts, both soluble and insoluble, of various strengths, and also in keeping oysters on a bottom of iron or copper salts —including rusty iron, old copper and copper fillings—but in none of these experiments (the full details of which will be published later) have they got sufficiently consistent and continuous results to enable them to determine whether or not the animal obtains its copper from the contents of the alimentary canal or from the water through the surface of the body. These experiments and observations are still being carried on. They add that the green oysters containing copper are found in some localities where there can be no question of copper mines or old copper from ships' bottoms, and suggest that the pigmentation may be due to a disturbed metabolism whereby the normal copper of the body becomes stored up in certain cells.

UNIVERSITY AND EDUCATIONAL NEWS.

IT will be possible for Columbia University to open its academic year at its new site on November 4th, though there may be some delay in certain of the laboratory courses. It is noteworthy that of the six buildings now erected, two are for general university purposes, a library and university hall (which at present contains only the powerhouse and gymnasium), while the four other buildings are for the sciences, Schermerhorn Hall for the natural sciences, Havermeyer Hall for chemistry, and halls for physics and engineering. These buildings for the sciences have been erected at a cost of over $1,200,000, and demonstrate the importance of the place now occupied by science in a modern university.

AT the opening exercises of Dartmouth College, President Tucker stated that the plans are well formulated for the proposed new physical laboratory, the result of the $75,000 bequest of the late Charles T. Wilder, of Lebanon, N. H. The committee has set apart $50,000 for its erection and $20,000 for maintenance. Additional appropriations have been made for an observatory, foundations for which will be laid at once.

OF the colleges that opened last week, Dartmouth, Lafayette and Dickinson report increases in the entering classes, which are 185, 106 and 60 respectively. The classes at Union and Beloit are smaller than usual.

THE Hon. William L. Wilson, formerly member of Congress and Postmaster-General, was inaugurated as President of Washington and Lee University, Lexington, Va., on September 15th. Addresses were made by President Gilman, Johns Hopkins University; Chancellor Kirkland, Vanderbilt University, and Professor Cameron, in the place of President Patton, Princeton University. President Wilson made an inaugural address.

THE Rev. James G. K. McClure, a Presbyterian clergyman, has been elected President of Lake Forest University.

AT Union College Mr. Frank S. Thompson, A.B. (Princeton), has been appointed assistant in physics, and Dr. A. A. Tylor, A.B. (Lafayette) and Ph.D. (Columbia), instructor in biology.

DR. W. E. THOMSON has been appointed professor of physiology at Anderson's College, Glasgow.

PROFESSOR CARL FRIEDHEIM, of Berlin, has been appointed professor of inorganic chemistry in the University at Bern, and Dr. Rodet professor of bacteriology at the University at Lyons.

DISCUSSION AND CORRESPONDENCE.

TYPES IN NATURAL HISTORY AND NOMENCLATURE OF RODENTS.

TO THE EDITOR OF SCIENCE: Three communications have recently appeared in SCIENCE, directly or indirectly relating to work of my own, and I would ask your permission to say a few words concerning them.

The first two are Mr. Charles Schuchert's paper on 'Types in Natural History*, and Dr. Merriam's† critique on it, and it is to the latter I would first refer.

With characteristic emphasis Dr. Merriam scorns Mr. Schuchert's suggestions for further names to represent different classes of types, and incidentally speaks of 'several obsolete

*SCIENCE, V., p. 636, April 23, 1897.

†SCIENCE, V., p. 731, May 7, 1897.

terms which have never been used, as far as I am aware, even by the man who proposed them.' This statement is not quite correct. 'The man who proposed them,' myself, has already used them several times in print, oftener still in labeling and registering specimens, and has every intention of continuing the practice. Nor is he the only one who has done so. Moreover, had none used them as yet, in print, four years is rather a short time in which to consider obsolete terms admittedly proposed only for occasional use. The clear expression by such words of the exact relations of the specimens under discussion to the original description has been found of so much value by those who have used them that it is easy to sympathize with any one dealing with the classes of types that Mr. Schuchert refers to, wishing to have equally handy names by which to speak of them.

Mr. Schuchert has proposed to alter the definition of a *paratype* so that it should only apply to such specimens as are described or measured in the original description. This seems by no means an improvement, as the idea of a paratype is that it is one of the specimens whose examination induced the author to found a new species. In what way he worded his description, which specimens he mentioned and which he did not, in no way affect this central idea. Moreover, it is just the more aberrant individuals, and the extremes in measurement, that would be likely to be mentioned, while those that are best and most representative as paratypes would tend to be passed over in silence.

Probably Mr. Schuchert's '*plastotype*' will be of use to paleontologists and others having occasion to deal with casts, but I fail to see the benefit of his terms *hypotype* and *genotype*, of which the former is too general to be of much definite use, while the latter is based on a confusion of ideas, as while the type of a species is a *specimen*, that of a genus is a *species*, so that no *specimen* can be typical of a *genus*.

The objection to 'hypotype' as being too general and covering too many specimens of different origins applies even more strongly to Lord Walsingham and Mr. Durrant's proposed extension* of *metatype* to cover *any* specimen named by the original author, whether topotype or not. Many a museum worker, who has to name large series of specimens from all sorts of localities, must constantly put under one of his own names specimens which may be anything but typical, and it would be absurd to call the whole of a museum series of a common animal 'metatypes' merely because the name of the species happened to have been proposed by the person who determined the specimens. Probably this result of their proposal had not presented itself to the authors referred to. But after reducing 'metatype' to its original sense, Walsingham and Durrant's term '*homotype*' might suitably be employed for any specimens that had been compared with the type, such specimens being, I believe, looked upon by entomologists with a respect which, in view of the difficulty of a proper comparison, mammalogists find a little hard to understand. But, as in other cases, if entomologists find the word useful, by all means let them use it, and let not those who don't want the word object to its use by those who do.

Lastly, may I express my pleasure at the advantage mammalogical nomenclature has gained by Mr. Palmer's critique* on my recent arrangement of rodents. Every zoological paper nowadays has two sides, a real and a nomenclatural, and it so happens that the nomenclatural side of the paper discussed is particularly susceptible of improvement, partly owing to the fact that the prospect of the appearance of Mr. Palmer's own list of mammalian genera made it obvious that any labor expended in this direction would be largely wasted, and partly because my own views of nomenclature underwent a radical change just as the paper was being printed, so that some names could be altered in accordance with the newer views, and others not.

To the omitted genus *Fiber*, *Dasymys* Peters† may be added, and may be placed at 43*a*, while *Nectomys*, also of the same author, should, as elsewhere pointed out, be restored to full rank, coming at 74*a*. It also proves that *Chiruromys* Thos., should give way to *Pogonomys* M. Edw.

* Merton Rules of Nomenclature, p. 13, 1896.

* SCIENCE, VI., p. 103, July 16, 1897.

† MB. AK. Berl., 1875, p. 12.

which, instead of being a synonym of *Uromys*, should take the former's place at 52.

One change which I myself pointed out in 1895, but forgot in 1896, has escaped the lynx eyes of Mr. Palmer, namely, that *Pygeretmus* Gloger * (1841) antedates and supersedes *Platycercomys* Brandt (1844), No. 117 of the list.

In what has been called the real part of the paper, I doubt if Mr. Palmer's criticisms on the suppression of the *Lophiomyidæ* and the separation of the *Spalacidæ* and *Bathyergidæ* would have been made had he ever compared the teeth—practically identical—of *Lophiomys* and *Cricetus cricetus*, or realized to what an extent similar fossorial habits may mask real differences by a superficial resemblance, so that the two families referred to, really incomparably more different in essentials than the Americen *Geomyidæ* and *Heteromyidæ*, have yet become so alike externally that zoologists of an earlier generation naturally thought them to be nearly allied.

But on these and other points further criticism is much to be desired, and I can only repeat how fortunate it is that my mistakes and omissions in the nomenclatural part of the paper should have had the advantage of revision by such an authority on the subject as Mr. Palmer.

OLDFIELD THOMAS.

MARRIAGE BY CAPTURE IN ARABIA.

Antar is a Bedouin romance reputed to have been written by Asmai, one of the learned men of the court of Haroun-al-Raschid, shortly before the beginning of the ninth century.† From the translation by Terrick Hamilton (London, 8vo., 1820), Vol. IV., pp. 388–9, the following description of an early Arabian marriage custom is quoted. The custom is a well known one. Asmai's explanation of it is new to me.

"Now, there was a certain curious custom current among the Arabs at that period. The night on which a bridegroom should wed his wife they brought a quantity of camel pack-saddles and heaped them one upon another, decorating them with magnificent garments. Here they conducted the bride, and having seated her on high, they said to the bridegroom, "Come on, now, for thy bride!" And the bridegroom rushed forward to carry her off, whilst the youths of the tribe, drawn up in line, right and left, with staves and stones in their hands, as soon as the bridegroom rushed forward, began beating and pelting him and doing their utmost to prevent his reaching his wife. If a rib or so were broken in the affair it was well for him; if he were killed it was his destiny.

"But should he reach his wife in safety, the people quitted him and no one attempted to approach him. ('I inquired about this circumstance,' says Asmai, 'and what it was they were about.' 'Asmai,' they answered, 'the meaning of this is to exhibit the bride to the warriors, that should her husband die, anyone else might take a fancy to her and take her off.')"

So far as my reading goes, the explanation of marriage by simulated capture, which is given in the last sentence, is entirely novel.

EDWARD S. HOLDEN.

LICK OBSERVATORY,
August 15, 1897.

* Naturgesch., p. 106.

† It is, in fact, a compilation of the XIIth century.

SCIENTIFIC LITERATURE.

The Foundations of Geometry. By B. A. W. RUSSELL. Cambridge: The University Press. 1897. Pp. xvi + 201.

Here is a book especially opportune, on a subject of transcendent interest. The author's mathematical equipment is refreshingly sound, and his metaphysical results are delightfully suggestive, even where the mathematician may feel constrained to return as verdict 'not proven.' So much the more to be regretted is it that the Chapter I., 'A Short History of Metageometry,' should open with a glaring error, as follows: "The liquefaction of Euclidean orthodoxy is the axiom of parallels, and it was by the refusal to admit this axiom without proof that Metageometry began. The *first* effort in this direction, *that of Legendre*, was inspired by the hope of deducing this axiom from the others."

Mr. Russell cites Halsted's Bibliography of Hyper-Space and Non-Euclidean Geometry (1878), but can evidently never have seen it, since its first page speaks of 'The enormous

number of unsatisfactory attempts to prove this postulate,' and states that Sohncke gives a list of 92 authors on the subject before 1837, and that Perronet Thompson gave in English an account of like attempts before 1833, the very year our author cites for Legendre.

Mr. Russell goes on to say :

"Parallels are defined by Legendre as lines in the same plane, such that, if a third line cut them, it makes the sum of the interior and opposite angles equal to two right angles. He proves without difficulty that such lines would not meet."

But so had every school boy in the subject, since this is part of Euclid, Book I, Prop. 28:

"Similarly he can prove that the sum of the angles of a triangle cannot exceed two right angles, and that if any one triangle has a sum equal to two right angles all triangles have the same sum."

But these very demonstrations were published just a century before Mr. Russell's '*first* effort,' in 1733, by Saccheri.

Mr. Russell proceeds to speak of 'The originator of the whole system, Gauss,' and then says: "In 1799, writing to W. Bolyai, Gauss enunciates the important theorem that in hyperbolic geometry there is a maximum to the area of a triangle."

How utterly misleading, nay, fantastic, is this statement will appear on quoting the letter from 'Halsted's Science Absolute of Space,' 4th edition, Austin, 1896, which our author cites. Gauss says:

"I very much regret that I did not make use of our former proximity to find out *more* about your investigations in regard to the first grounds of geometry; I should certainly thereby have spared myself much vain labor, and would have become more restful than any one, such as I, can be, so long as on such a subject there yet remains so much to be wished for.

"In my own work thereon I myself have advanced far (though my other wholly heterogeneous employments leave me little time therefor), but *the* way, which I have hit upon, leads not so much to the goal which one wishes and which you assure me you have reached, as much more to making doubtful the truth of geometry.

"Indeed, I have come upon much, which with most no doubt would pass for a proof, but which in my eyes proves as good as NOTHING.

"For example, if one could prove that a rectilineal triangle is possible, whose content may be greater than any given surface, then I am in condition to prove with perfect rigor all geometry.

"Most would, indeed, let that pass as an axiom ; I not ; it might well be possible that, how far apart soever one took the three vertices of the triangle in space, yet the content was always under a given limit.

"I have more such theorems, but in none do I find anything satisfying."

From this letter it is perfectly clear that in 1799, so far from having the remotest idea of a hyperbolic geometry, or any non-Euclidean geometry, Gauss was still trying to prove that Euclid's is the only non-contradictory system of geometry and that it is the system of the external space of our physical experience. The first is false; the second can never be proved. But that both Gauss and W. Bolyai continued for the next five years to pound away in attempts to do the impossible, we have now obtained demonstrative evidence, in recovering a treatise finished and sent to Gauss by W. Bolyai in 1804.

In a great casket at Maros-Vásárhely all the unpublished papers of Bolyai János are preserved. All were placed freely at my disposal on my pilgrimage to this shrine of the non-Euclidean geometry. There, with extended researches anticipating the discoveries of Cayley and Klein in this subject, is an autobiography of János containing extracts from two letters written by Gauss to W. Bolyai (Farkas) and of transcendent importance as freeing János forever from the calumny again repeated by Mr. Russell where he says:

p. 12. "Gauss was, as we have seen, the inspirer of Wolfgang Bolyai. Wolfgang appears to have left to his son, Johann, the detailed working out of the hyperbolic system."

Nothing could be more false.

János, wholly unaided, discovered by himself the non-Euclidean geometry and taught it to Wolfgang, who transmitted it to Gauss. The two letters quoted by János are one before and one after this transmission.

This cry from the dead for tardy justice has since been shown exactly accurate by my friend, Fr. Schmidt, of Budapest, finding that the originals of these letters in the handwriting of Gauss still exist at Göttingen. The first is dated November 25, 1804, in answer to a letter

from W. Bolyai of September 16, 1804, accompanied by a Latin treatise, *Theoria parallelarum.*

It read as follows: "Now * * * yet somewhat about your geometric communication. I have read through your treatise with great interest and attention, and am right delighted at its really profound keenness. But you do not wish my empty praise, which also might seem in a measure partial because your train of ideas has very great resemblance to the way I formerly sought the untieing of this Gordian knot and vainly seek till now. You wish only my candid, open judgment. And this is, that your procedure does not give me satisfaction. I will seek, with as much clearness as I can, to bring to light the stone of stumbling which I still find therein (and which also again pertains to the same *group* of rocks wheron my attempts have hitherto been wrecked).

"I have indeed yet ever the hope that those rocks some day, and even before my end, will grant a thoroughfare. Meanwhile I have now so much other business on hand that I at present cannot think thereon, and, believe me, it will heartily delight me if you precede me and attain to overmaster all obstacles. I would, then, with inmost joy, do all in my power to make your service current and put it in the light.

* * * * * * * * *

Could you prove $dke = ekf = fkg$, etc., then would the thing be perfect. But this theorem is indeed true, only difficult to prove rigorously without already presupposing the theory of parallels. * *
You have my candid judgment. I have given it, and I repeat that it would genuinely delight me if you overcome all difficulties."

Here we see, with startling clearness, that in 1804 both Gauss and W. Bolyai (Bolyai Farkas) believe that Euclid's Parallel-Postulate can be proven, and indeed are racing to demonstrate it.

Before the next letter the unaided genius of the son, Bolyai János, has created the new universe, has found out all about it, mapped it, and proved Euclid's Postulate forever indemonstrable.

In transmitting in print to Gauss the immortal treatise of his son János, the most marvellous two dozen pages in the whole history of human thought, the father, Farkas, writes on June 20, 1831:

"My son is already First Lieutenant in the Engigineering Corps, and will soon be Captain, a handsome youth, a virtuoso on the violin, a fine fencer and brave, but has often dueled, and is still altogether too wild a soldier—but also very refined—light in darkness and darkness in light, and an impassioned mathematician with very rare gifts of mind. At present he is in the garrison at Lemberg—a great admirer of you—capable of understanding and appreciating you. At his desire, I send you this little work of his. Have the goodness to judge it with your sharp, penetrating eye, and to write your high judgment unsparingly in your answer, which I ardently await. It is the first beginning of my work, which is under the press. I would gladly send with this the first volume, but it is not yet out.

"According to my view, is in the work of my son, u (namely, where a first does not cut the b) geometrically constructed; whence, however, is not determined how great u is, from O on up to R (that excluded, this included).

"Yet everything in geometry is either dependent on u or not; (*e. g.*) spherical trigonometry is in § 26 settled as independent of it. * * *

"At the end he also shows that if u not $= R$, then the circle can be squared."

Thus we see that the treatise sent to Gauss on June 20, 1831, was the immortal Appendix just as published. The Gordian knot, at which Gauss himself had for years tried in vain, was here forever gloriously untied.

After waiting six months the anxious father tries again, and on January 16, 1832, once more sends Gauss the work of János, saying in the accompanying letter:

"My son was not present when his little work was printed. He had printed the errata (which follow); in order to be less burdensome to you, I have corrected the most with a pen.

"He writes from Lemberg that he has since simplified and made more elegant many things, and has proven the impossibility of determining *a priori* whether Axiom XI be true or not."

To this, on March 6, 1832, comes from Gauss at length an answer as follows:

* * * "Now somewhat about the work of your son:

"If I thus begin 'that I dare not praise it' you will a moment wonder; but I cannot otherwise; to praise it would mean to praise myself. For the whole content of the book, the way your son has hit out and the results to which he is led, are identical almost throughout with my own meditations, made in part already 30–35 years ago. In fact, I am thereby extremely delighted. My intention was to let nothing be known during my lifetime of my own work, of which moreover until now little has been put on paper. Most men have not at all the right sense for

what is here in question, and I have found only few people who received with special interest that which I communicated to them. In order for that one must first have felt right keenly what really is lacking, and about that most men are wholly indistinct.

"On the other hand, my intention was, with time, to put all on paper, so that it at least would not hereafter perish with me.

"Therefore am I greatly pleased that this trouble can now be spared me, and it is most highly delightful to me that the son of just my old friend is he who in so remarkable a way has anticipated me.

"I find his notations very pregnant and abridging. Yet I believe it would be good to establish for many chief ideas not merely symbols or letters, but definite names, and I have already since long thought of some such names.

"So long as one thinks through the thing only in immediate intuition, one needs no name or symbol; these are first necessary, if one wishes to be comprehensible to others. So, for example, the surface which your son calls F could be called a Parasphere, the line L a Paracykle: they are, in fact, spheres or circles of infinite radius. Hypercykle could be named the complex of all points which have like distance from a straight with which they lie in a plane; even so Hypersphere. Yet those are all only unimportant incidents; the main thing is the matter, not the form.

* * * * * *

"Just exactly in the impossibility to decide *a priori* between Σ and S lies the clearest proof that Kant was wrong to maintain, Space is *only Form* of our intuition."

About the other independent discoverer of the non-Euclidean geometry, Lobachévski, Gauss writes to Schumacher, November 28, 1846, without a word of reference to Bolyai, as follows:

"I have lately had occasion to reread the opuscule of Lobatschewsky, intitled: *Geometrische Untersuchungen zur Theorie der Parallellinien.* This opuscle contains the elements of the geometry which would exist and development of which would form a rigorous chain, if the *Euclidean* geometry were not true. * * * You know that since fifty-four years (since 1792) I share the same convictions, without speaking here of certain developments which my ideas on this subject have since received. Therefore, I have not found in the work of Lobachevski any fact new to me; but the exposition is wholly different from that which I had projected, and the author has treated the matter with a master hand and with the veritable geometric spirit."

How reconcile these letters with that of 1804? And since one says that Bolyai's exposition is identical with that of Gauss, while the other declares Lobachévski's wholly different from that, how reconcile them with the statement of Mr. Russell, p. 11: "Very similar [to Lobachévski's] is the system of *Johann Bolyai*, so similar, indeed, as to make the independence of the two works, though a well-authenticated fact, seem all but incredible?"

This letter of 1846 shows no hint of that other sort of non-Euclidean geometry which Riemann gave in his wonderful Probevorlesung, 'Ueber die Hypothesen welche der Geometrie zu Grunde liegen,' June 10, 1854.

But this dissertation was not published until 1867, so that the waters of oblivion seemed to close over it as over the works of Bolyai and Lobachévski.

Mr. Russell should not have omitted in his text all mention of Hoüel, for Hoüel it was who resurrected the non-Euclidean geometry, beginning with his own essay on the fundamental principles of geometry, published in 1863 at Greifswald. (See his life in the *Amer. Math. Monthly*, April, 1897.)

But not to give too much space to actual slips in history we must jump to the second of Mr. Russell's four chapters, 'Critical account of some previous philosophical theories of geometry:'

"The importance of geometry in the theories of knowledge which have arisen in the past can scarcely be exaggerated."

The author believes that the usual forms of non-Euclidean geometry, the hyperbolic, the double elliptic and the single elliptic are the only logically self-consistent systems, and so says: "I shall contend that those axioms, which Euclid and Metageometry have in common, coincide with those properties of any form of externality which are deducible, by the principle of contradiction, from the possibility of experience of an external world."

We see at once that pure projective geometry must be of supreme weight for him.

It is a treat to see our author overwhelm the apparent subordination of the non-Euclidean spaces by the introduction of different measures of distance. This was the painful mistake of

Emory McClintock in his article 'On the non-Euclidean geometry' in the Bulletin of the N. Y. (Amer.) Math. Soc., Vol. II., pp. 21–33, which reached the pitiful conclusion (p. 32): "The chief lesson to be obtained from all non-euclidian diversions (sic) is that the distinguishing mark of euclidian geometry is fixity of distance—measurement."

Mr. Russell, with equal deftness, puts in pillory the gross blunder made by Andrew W. Phillips and Irving Fisher, professors in Yale University, in the note on p. 23 of their Elements of Geometry, where they say: "Lobatchewsky in 1829 proved that we can never get rid of the parallel axiom without assuming the space in which we live to be very different from *what we know it to be through experience.*"

By experience, of course, we can never know or prove our space to be other than a non-Euclidean space with a comparatively large constant. How unexpected, then, the error of Professor H. Schubert, of Hamburg, in the *Monist*, Vol. VI., No. 2, p. 295, where he says:

> "Let me recall the controversy which has been waged in this century regarding the eleventh axiom of Euclid, that only one line can be drawn through a point parallel to another straight line. The discussion merely touched the question whether the axiom was capable of demonstration solely by means of the other propositions, or whether it was not a special property, *apprehensible only by sense-experience*, of that space of three dimensions in which the organic world has been produced."

After 20 years' study of writers on the non-Euclidean geometry, the present reviewer cannot recall even one who was ever silly enough to think that the exact equality of the angle-sum of a rectilineal triangle to two right angles was apprehensible by sense-experience, or could ever be known through experience.

This new Yale geometry also makes the old *petitio principii* of defining a straight line as the *shortest* distance between two points. This our author treats in his third chapter, p. 167:

> "We are accustomed to the definition of the straight line as the *shortest* distance between two points. * * * Unless we presuppose the straight line, we have no means of comparing the lengths of different curves and can, therefore, never discover the applicability of our definition."

In projective geometry any two points uniquely determine a line, *the straight*. But any two points and their straight are, in pure projective geometry, utterly indistinguishable from any other point-pair and their straight. It is of the essence of metric geometry that two points shall completely determine a spatial quantity, *the sect*. If our author had used for this fundamental spatial magnitude this name, introduced in 1881, his exposition would have gained wonderfully in clearness.

Both the accepted popular and the accepted mathematical definition of 'distance' make it always a number, as, *e. g.*, the Cayley-Klein definition: "The distance between two points is equal to a constant times the logarithm of the cross ratio in which the line joining the two points is divided by the fundamental quadric."

It is the misfortune of our author to use the already overworked and often misused word 'distance' as a confounding and confusing designation for a sect itself and also the measures of that sect, whether by superposition, ordinary ratio, indeterminate as depending on the choice of a unit, or projective metrics, indeterminate as depending on the fixing of the two points to be taken as constant in the varying cross ratios.

This whole book might be cited as an overwhelming vindication of the only American treatise on Projective Geometry against the attack on it made by a critic in SCIENCE, because, forsooth, it was founded and developed as *pure* projective geometry, without any quantitative ideas whatever.

Into the fourth and last chapter, 'Philosophical Consequences,' we will not here go. Suffice it to say that Projective and Metric Geometry, though eternally separate in essence, and each unable ever to absorb the other, are happily wedded, and expand joyfully ever after.

GEORGE BRUCE HALSTED.

AUSTIN, TEXAS.

Sight: An Exposition of the Principles of Monocular and Binocular Vision. JOSEPH LE CONTE. New York, D. Appleton & Co. 1897. Second edition, revised and enlarged. Pp. xvi + 318. $1.50.

A revised and enlarged edition of Professor

Le Conte's book on 'Sight' is extremely welcome. It remains true now, as it was in 1880, when the first edition was published, that there is no other book in the English language covering this field. During the past year two excellent American contributions have, indeed, been made to the subject—Professor Bowditch's survey in the 'American Text-book of Physiology' and the various articles in the 'Systems of Diseases of the Eye,' by Norris and Oliver. But Professor Le Conte's book is the only treatise covering the subject of vision in English, and, in fact, in any language, with the exception of the more technical works of von Helmholtz and Aubert. While it is surprising, and not altogether creditable to the 'new psychology,' that we have only one book on the subject, it is fortunate that it is so excellent.

Professor Le Conte devotes two-thirds of his book to binocular vision. This is excessive for a text-book, but it is justified by the interest of the subject and by the important original contributions of the author. Following an introduction on the senses, the part on monocular vision includes sections on the general structure of the eye, the formation of the image, the perfect eye, defects of the eye, structure of the retina, space perception and color perception. In this part should, perhaps, be included the final chapter on the evolution of the eye, added in this edition, which, however, appears as the 7th chapter of the third part, entitled in the table of contents, 'Some abstruser points, especially in binocular vision,' and in the text, 'On some disputed points in binocular vision.'

The author has added some new matter to this first part, especially on color blindness and color perception, including a full statement of the Donders-Franklin theory. I regret the omission or brief treatment of subjects so important as the intensity of sensations, their time relations, the field of vision, illusions, the combination of colors,* etc. It is in any case evident that everything cannot be included in 100 pages, and it is a wonder that Professor Le Conte has been able to give with such clearness so much. There are several points on which I should differ with the author. For example, the explanation of 'upright vision,' which has been discussed in this JOURNAL. Professor Stratton, a colleague of Professor Le Conte's at the University of California, has since made the ingenious experiment of wearing, for several days, glasses that inverted the normal retinal image and shows how quickly adjustment is made. But it is still easier to stand on one's head and notice that the landscape is not seen inverted.

The two parts on binocular vision contain clear and concise accounts of experiments largely devised by Professor Le Conte. Making these experiments would, as the author says, be for any one an admirable culture in scientific method. Many of the experiments are valuable contributions to science, but the details are somewhat complex and cannot be made clear in a review. The reader must turn to Professor Le Conte's book, with its many new and ingenious illustrations, in order to appreciate the importance of a study of binocular vision and the great value of the author's contributions to the subject. I may note that I have recently been told by an eminent oculist that the conflicting results in the case of Listing's law found by von Helmholtz were due to unrecognized astigmatism in his eyes.

There are some points where Professor Le Conte's statements do not seem to me quite accurate. For example, he says, "We always see things double, except under certain conditions." This is scarcely correct psychology; we must learn by practice to see things double, and then usually see them double only while the experiment lasts. Professor Le Conte says, "I believe that the existence of the central spot is necessary to fixed, *thoughtful attention*, and this, again, in its turn, is necessary for the development of the higher faculties of the mind." But may not the mental faculties of those born blind be developed? There are further many subjects, such as the horopter, that I cannot regard as finally solved by Professor Le Conte, but his researches have accomplished much toward their solution and should be accepted as the basis of future work.

J. McKEEN CATTELL.

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*Fortunately some of these topics are fully treated in another admirable book in this same series, Professor Rood's 'Modern Chromatics.'

SCIENCE

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FRIDAY, OCTOBER 1, 1897.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*AN UNDISCOVERED GAS.**

A SECTIONAL address to members of the British Association falls under one of three heads. It may be historical, or actual, or prophetic; it may refer to the past, the present or the future. In many cases, indeed in all, this classification overlaps. Your former presidents have given sometimes a historical introduction, followed by an account of the actual state of some branch of our science, and, though rarely, concluding with prophetic remarks. To those who have an affection for the past, the historical side appeals forcibly; to the practical man, and to the investigator engaged in research, the actual, perhaps, presents more charm; while to the general public, to whom novelty is often more of an attraction than truth, the prophetic aspect excites most interest. In this address I must endeavor to tickle all palates; and perhaps I may be excused if I take this opportunity of indulging in the dangerous luxury of prophecy, a luxury which the managers of scientific journals do not often permit their readers to taste.

The subject of my remarks to-day is a new gas. I shall describe to you later its curious properties; but it would be unfair not to put you at once in possession of the knowledge of its most remarkable property —it has not yet been discovered. As it is still unborn, it has not yet been named. The naming of a new element is no easy matter. For there are only twenty-six letters in our alphabet, and there are already over seventy elements. To select a name expressible by a symbol which has not al-

* Address to the Chemical Section, British Association for the Advancement of Science, Toronto, 1897, by the President of the Section.

ready been claimed for one of the known elements is difficult, and the difficulty is enhanced when it is at the same time required to select a name which shall be descriptive of the properties (or want of properties) of the element.

It is now my task to bring before you the evidence for the existence of this undiscovered element.

It was noticed by Döbereiner, as long ago as 1817, that certain elements could be arranged in groups of three. The choice of the elements selected to form these triads was made on account of their analogous properties, and on the sequence of their atomic weights, which had at that time only recently been discovered. Thus calcium, strontium and barium formed such a group; their oxides, lime, strontia and baryta are all easily slaked, combining with water to form soluble lime-water, strontia-water and baryta-water. Their sulphates are all sparingly soluble and resemblance had been noticed between their respective chlorides and between their nitrates. Regularity was also displayed by their atomic weights. The numbers then accepted were 20, 42.5 and 65; and the atomic weight of strontium, 42.5, is the arithmetical mean of those of the other two elements, for $(65+20)/2 = 42.5$. The existence of other similar groups of three was pointed out by Döbereiner, and such groups became known as 'Döbereiner's triads.'

Another method of classifying the elements, also depending on their atomic weights, was suggested by Pettenkofer, and afterwards elaborated by Kremers, Gladstone and Cooke. It consisted in seeking for some expression which would represent the differences between the atomic weights of certain allied elements. Thus, the difference between the atomic weight of lithium, 7, and sodium, 23, is 16; and between that of sodium and of potassium, 39, is also 16. The regularity is not always so conspicuous; Dumas, in 1857, contrived a somewhat complicated expression, which, to some extent, exhibited regularity in the atomic weights of fluorine, chlorine, bromine, and iodine, and also of nitrogen, phosphorus, arsenic, antimony and bismuth.

The upshot of these efforts to discover regularity was that, in 1864, Mr. John Newlands, having arranged the elements in eight groups, found that when placed in the order of their atomic weights, 'the eighth element, starting from a given one, is a kind of repetition of the first, like the eighth note of an octavo in music.' To this regularity he gave the name 'The Law of Octaves.'

The development of this idea, as all chemists know, was due to the late Professor Lothar Meyer, of Tübingen, and to Professor Mendeléeff, of St. Petersburg. It is generally known as the 'Periodic Law.' One of the simplest methods of showing this arrangement is by means of a cylinder divided into eight segments by lines drawn parallel to its axis; a spiral line is then traced round the cylinder, which will, of course, be cut by these lines eight times at each revolution. Holding the cylinder vertically, the name and atomic weight of an element is written at each intersection of the spiral with a vertical line, following the numerical order of the atomic weights. It will be found, according to Lothar Meyer and Mendeléeff, that the elements grouped down each of the vertical lines form a natural class; they possess similar properties, form similar compounds, and exhibit a graded relationship between their densities, melting points, and many of their other properties. One of these vertical columns, however, differs from the others, inasmuch as on it there are three groups, each consisting of three elements with approximately equal atomic weights. The elements in question are iron, cobalt and nickel; palladium, rhodium and ruthenium; and platinum,

iridium and osmium. There is apparently room for a fourth group of three elements in this column, and it may be a fifth. And the discovery of such a group is not unlikely, for when this table was first drawn up Professor Mendeléeff drew attention to certain gaps, which have since been filled up by the discovery of gallium, germanium and others.

The discovery of argon at once raised the curiosity of Lord Rayleigh and myself as to its position in this table. With a density of nearly 20, if a diatomic gas, like oxygen and nitrogen, it would follow fluorine in the periodic table; and our first idea was that argon was probably a mixture of three gases, all of which possessed nearly the same atomic weights, like iron, cobalt and nickel. Indeed, their names were suggested, on this supposition, with patriotic bias, as Anglium, Scotium and Hibernium! But when the ratio of its specific heats had, at least in our opinion, unmistakably shown that it was molecularly monatomic, and not diatomic, as at first conjectured, it was necessary to believe that its atomic weight was 40, and not twenty, and that it followed chlorine in the atomic table and not fluorine. But here arises a difficulty. The atomic weight of chlorine is 35.5, and that of potassium, the next element in order in the table, is 39.1; and that of argon, 40, follows, and does not precede, that of potassium, as it might be expected to do. It still remains possible that argon, instead of consisting wholly of monatomic molecules, may contain a small percentage of diatomic molecules; but the evidence in favor of this supposition is, in my opinion, far from strong. Another possibility is that argon, as at first conjectured, may consist of a mixture of more than one element; but, unless the atomic weight of one of the elements in the supposed mixture is very high, say 82, the case is not bettered, for one of the elements in the supposed trio would still have a higher atomic weight than potassium. And very careful experiments, carried out by Dr. Norman Collie and myself, on the fractional diffusion of argon, have disproved the existence of any such element with high atomic weight in argon, and, indeed, have practically demonstrated that argon is a simple substance and not a mixture.

The discovery of helium has thrown a new light on this subject. Helium, it will be remembered, is evolved on heating certain minerals, notably those containing uranium; although it appears to be contained in others in which uranium is not present, except in traces. Among these minerals are clèveite, monazite, fergusonite, and a host of similar complex mixtures, all containing rare elements, such as niobium, tantalum, yttrium, cerium, etc. The spectrum of helium is characterized by a remarkably brilliant yellow line, which had been observed as long ago as 1868 by Professors Frankland and Lockyer in the spectrum of the sun's chromosphere, and named 'helium' at that early date.

The density of helium proved to be very close to 2.0, and, like argon, the ratio of its specific heat showed that it, too, was a monatomic gas. Its atomic weight, therefore, is identical with its molecular weight, viz., 4.0, and its place in the periodic table is between hydrogen and lithium, the atomic weight of which is 7.0.

The difference between the atomic weights of helium and argon is thus 36, or 40 — 4. Now there are several cases of such a difference. For instance, in the group the first member of which is fluorine we have:

Fluorine	19	
		16.5
Chlorine	35.5	
		19.5
Manganese	55	

In the oxygen group—

Oxygen	16	
		16
Sulphur	32	
		20.3
Chromium	52.3	

In the nitrogen group—

Nitrogen	14	
		17
Phosphorus	31	
		20.4
Vanadium	51.4	

And in the carbon group—

Carbon	12	
		16.3
Silicon	28.3	
		19.8
Titanium	48.1	

These instances suffice to show that approximately the differences are 16 and 20 between consecutive members of the corresponding groups of elements. The total differences between the extreme members of the short series mentioned are—

Manganese—Fluorine	36
Chromium—Oxygen	36.3
Vanadium—Nitrogen	37.4
Titanium—Carbon	36.1

This is approximately the difference between the atomic weights of helium and argon, 36.

There should, therefore, be an undiscovered element between helium and argon, with an atomic weight 16 units higher than that of helium, and 20 units lower than that of argon, namely 20. And if this unknown element, like helium and argon, should prove to consist of monatomic molecules, then its density should be half its atomic weight, 10. And pushing the analogy still farther, it is to be expected that this element should be as indifferent to union with other elements as the two allied elements.

My assistant, Mr. Morris Travers, has indefatigably aided me in a search for this unknown gas. There is a proverb about looking for a needle in a haystack; modern science, with the aid of suitable magnetic appliances, would, if the reward were sufficient, make short work of that proverbial needle. But here is a supposed unknown gas, endowed, no doubt, with negative properties and the whole world to find it in. Still, the attempt had to be made.

We first directed our attention to the sources of helium—minerals. Almost every mineral which we could obtain was heated in a vacuum, and the gas which was evolved examined. The results are interesting. Most minerals give off gas when heated, and the gas contains, as a rule, a considerable amount of hydrogen, mixed with carbonic acid, questionable traces of nitrogen, and carbonic oxide. Many of the minerals, in addition, gave helium, which proved to be widely distributed, though only in minute proportion. One mineral—malacone—gave appreciable quantities of argon; and it is noteworthy that argon was not found except in it (and, curiously, in much larger amount than helium), and in a specimen of meteoric iron. Other specimens of meteoric iron were examined, but were found to contain mainly hydrogen, with no trace of either argon or helium. It is probable that the sources of meteorites might be traced in this manner, and that each could be relegated to its particular swarm.

Among the minerals examined was one to which our attention had been directed by Professor Lockyer, named eliasite, from which he said that he had extracted a gas in which he had observed spectrum lines foreign to helium. He was kind enough to furnish us with a specimen of this mineral, which is exceedingly rare, but the sample which we tested contained nothing but undoubted helium.

During a trip to Iceland, in 1895, I collected some gas from the boiling springs there; it consisted, for the most part, of air, but contained somewhat more argon than is usually dissolved when air is shaken with water. In the spring of 1896 Mr. Travers and I made a trip to the Pyrenees to collect gas from the mineral springs of Cauterets, to which our attention had been directed by Dr. Bouchard, who pointed out that these gases are rich in helium. We examined a number of samples from the

various springs, and confirmed Dr. Bouchard's results, but there was no sign of any unknown lines in the spectrum of these gases. Our quest was in vain.

We must now turn to another aspect of the subject. Shortly after the discovery of helium its spectrum was very carefully examined by Professors Runge and Paschen, the renowned spectroscopists. The spectrum was photographed, special attention being paid to the invisible portions, termed the 'ultra-violet' and 'infra-red.' The lines thus registered were found to have a harmonic relation to each other. They admitted of division into two sets, each complete in itself. Now, a similar process had been applied to the spectrum of lithium and to that of sodium, and the spectra of these elements gave only one series each. Hence, Professors Runge and Paschen concluded that the gas, to which the provisional name of helium had been given, was, in reality, a mixture of two gases, closely resembling each other in properties. As we know no other elements with atomic weights between those of hydrogen and lithium, there is no chemical evidence either for or against this supposition. Professor Runge supposed that he had obtained evidence of the separation of these imagined elements from each other by means of diffusion; but Mr. Travers and I pointed out that the same alteration of spectrum, which was apparently produced by diffusion, could also be caused by altering the pressure of the gas in the vacuum tube; and shortly after Professor Runge acknowledged his mistake.

These considerations, however, made it desirable to subject helium to systematic diffusion, in the same way as argon had been tried. The experiments were carried out in the summer of 1896, by Dr. Collie and myself. The result was encouraging. It was found possible to separate helium into two portions of different rates of diffusion, and consequently of different density by this means. The limits of separation, however, were not very great. On the one hand, we obtained gas of a density close on 2.0; and on the other, a sample of density 2.4 or thereabouts. The difficulty was increased by the curious behavior, which we have often had occasion to confirm, that helium possesses a rate of diffusion too rapid for its density. Thus, the density of the lightest portion of the diffused gas, calculated from its rate of diffusion, was 1.874; but this corresponds to a real density of about 2.0. After our paper, giving an account of these experiments, had been published, a German investigator, Herr A. Hagenbach, repeated our work and confirmed our results.

The two samples of gas of different density differ also in other properties. Different transparent substances differ in the rate at which they allow light to pass through them. Thus, light travels through water at a much slower rate than through air, and at a slower rate through air than through hydrogen. Now Lord Rayleigh found that helium offers less opposition to the passage of light than any other substance does, and the heavier of the two portions into which helium had been split offered more opposition than the lighter portion. And the retardation of the light, unlike what has usually been observed, was nearly proportional to the densities of the samples. The spectrum of these two samples did not differ in the minutest particular; therefore it did not appear quite out of the question to hazard the speculation that the process of diffusion was instrumental, not necessarily in separating two kinds of gas from each other, but actually in removing light molecules of the same kind from heavy molecules. This idea is not new. It had been advanced by Prof. Schützenberger (whose recent death all chemists have to deplore), and later, by Mr. Crookes, that what we term the atomic weight of an

element is a mean; that when we say that the atomic weight of oxygen is 16 we merely state that the average atomic weight is 16; and it is not inconceivable that a certain number of molecules have a weight somewhat higher than 32, while a certain number have a lower weight.

We therefore thought it necessary to test this question by direct experiment with some known gas; and we chose nitrogen, as a good material with which to test the point. A much larger and more convenient apparatus for diffusing gases was built by Mr. Travers and myself, and a set of systematic diffusions of nitrogen was carried out. After thirty rounds, corresponding to 180 diffusions, the density of the nitrogen was unaltered, and that of the portion which should have diffused most slowly, had there been any difference in rate, was identical with that of the most quickly diffusing portion, *i. e.*, with that of the portion which passed first through the porous plug. This attempt, therefore, was unsuccessful; but it was worth carrying out, for it is now certain that it is not possible to separate a gas of undoubted chemical unity into portions of different density by diffusion. And these experiments rendered it exceedingly improbable that the difference in density of the two fractions of helium was due to separation of light molecules of helium from heavy molecules.

The apparatus used for diffusion had a capacity of about two litres. It was filled with helium, and the operation of diffusion was carried through thirty times. There were six reservoirs, each full of gas, and each was separated into two by diffusion. To the heavier portion of one lot the lighter portion of the next was added, and in this manner all six reservoirs were successively passed through the diffusion apparatus. This process was carried out thirty times, each of the six reservoirs having had its gas diffused each time thus involving 180 diffusions.

After this process the density of the more quickly diffusing gas was reduced to 2.02, while that of the less quickly diffusing had increased to 2.27. The light portion on rediffusion hardly altered in density, while the heavier portion, when divided into three portions by diffusion, showed a considerable difference in density between the first third and the last third. A similar set of operations was carried out with a fresh quantity of helium, in order to accumulate enough gas to obtain a sufficient quantity for a second series of diffusions. The more quickly diffusing portions of both gases were mixed and re-diffused. The density of the lightest portion of these gases was 1.98, and after other 15 diffusions the density of the lightest portion had not decreased. The end had been reached; it was not possible to obtain a lighter portion by diffusion. The density of the main body of this gas is therefore 1.98; and its refractivity, air being taken as unity, is 0.1245. The spectrum of this portion does not differ in any respect from the usual spectrum or helium.

As re-diffusion does not alter the density or the refractivity of this gas, it is right to suppose that either one definite element has now been isolated or that if there are more elements than one present they possess the same, or very nearly the same, density and refractivity. There may be a group of elements, say three, like iron, cobalt and nickel; but there is no proof that this idea is correct and the simplicity of the spectrum would be an argument against such a supposition. This substance, forming by far the larger part of the whole of the gas, must, in the present state of our knowledge, be regarded as pure helium.

On the other hand, the heavier residue is easily altered in density by re-diffusion, and this would imply that it consists of a

small quantity of a heavy gas mixed with a large quantity of the light gas. Repeated re-diffusion convinced us that there was only a very small amount of the heavy gas present in the mixture. The portion which contained the largest amount of heavy gas was found to have the density 2.275, and its refractive index was found to be 0.1333. On re-diffusing this portion of gas until only a trace sufficient to fill a Plücker's tube was left, and then examining the spectrum, no unknown lines could be detected, but, on interposing a jar and spark gap, the well-known blue lines of argon became visible; and even without the jar the red lines of argon and the two green groups were distinctly visible. The amount of argon present, calculated from the density, was 1.64 per cent., and from the refractivity 1.14 per cent. The conclusion had therefore to be drawn that the heavy constituent of helium, as it comes off the minerals containing it, is nothing new, but, so far as can be made out, merely a small amount of argon.

If, then, there is a new gas in what is generally termed helium, it is mixed with argon, and it must be present in extremely minute traces. As neither helium nor argon has been induced to form compounds, there does not appear to be any method, other than diffusion, for isolating such a gas, if it exists, and that method has failed in our hands to give any evidence of the existence of such a gas. It by no means follows that the gas does not exist; the only conclusion to be drawn is that we have not yet stumbled on the material which contains it. In fact, the haystack is too large and the needle too inconspicuous. Reference to the periodic table will show that between the elements aluminium and indium there occurs gallium, a substance occurring only in the minutest amount on the earth's surface; and following silicon, and preceding tin, appears the element germanium, a body which has as yet been recognized only in one of the rarest of minerals, argyrodite. Now, the amount of helium in fergusonite, one of the minerals which yields it in reasonable quantity, is only 33 parts by weight to 100,000 of the mineral; and it is not improbable that some other mineral may contain the new gas in even more minute proportion. If, however, it is accompanied in its still undiscovered source by argon and helium, it will be a work of extreme difficulty to effect a separation from these gases.

In these remarks it has been assumed that the new gas will resemble argon and helium in being indifferent to the action of reagents, and in not forming compounds. This supposition is worth examining. In considering it the analogy with other elements is all that we have to guide us.

We have already paid some attention to several triads of elements. We have seen that the differences in atomic weights between the elements fluorine and manganese, oxygen and chromium, nitrogen and vanadium, carbon and titanium, is in each case approximately the same as that between helium and argon, viz., 36. If elements further back in the periodic table be examined, it is to be noticed that the differences grow less, the smaller the atomic weights. Thus, between boron and scandium, the difference is 33; between beryllium (glucinum) and calcium, 31; and between lithium and potassium, 32. At the same time, we may remark that the elements grow liker each other the lower the atomic weights. Now helium and argon are very like each other in physical properties. It may be fairly concluded, I think, that in so far they justify their position. Moreover, the pair of elements which show the smallest difference between their atomic weights is beryllium and calcium; there is somewhat greater difference between lithium and potassium. And it is in accordance

with this fragment of regularity that helium and argon show a greater difference. Then, again, sodium, the middle element of the lithium triad, is very similar in properties both to lithium and potassium; and we might, therefore, expect that the unknown element of the helium series should closely resemble both helium and argon.

Leaving now the consideration of the new element, let us turn our attention to the more general question of the atomic weight of argon, and its anomalous position in the periodic scheme of the elements. The apparent difficulty is this: The atomic weight of argon is 40; it has no power to form compounds, and thus possesses no valency; it must follow chlorine in the periodic table, and precede potassium; but its atomic weight is greater than that of potassium, whereas it is generally contended that the elements should follow each other in the order of their atomic weights. If this contention is correct, argon should have an atomic weight smaller than 40.

Let us examine this contention. Taking the first row of elements, we have:

Li = 7, Be = 9.8, B = 11, C = 12, N = 14, O = 16, F = 19, ? = 20.

The differences are:

2.8, 1.2, 1.0, 2.0, 2.0, 3.0, 1.0.

It is obvious that they are irregular. The next row shows similar irregularities. Thus:

(? = 20), Na = 23, Mg = 24.3, Al = 27, Si = 28, P = 31, S = 32, Cl = 35.5, A = 40.

And the differences:

3.0, 1.3, 2.7, 1.0, 3.0, 1.0, 3.5, 4.5.

The same irregularity might be illustrated by a consideration of each succeeding row. Between argon and the next in order, potassium, there is a difference of —0.9; that is to say, argon has a higher atomic weight than potassium by 0.9 unit; whereas it might be expected to have a lower one, seeing that potassium follows argon in the table. Farther on in the table there is a similar discrepancy. The row is as follows:

Ag = 108, Cd = 112, In = 114, Sn = 119, Sb = 120.5, Te = 127.7, I = 127.

The differences are:

4.0, 2.0, 5.0, 1.5, 7.2, —0.7.

Here, again, there is a negative difference between tellurium and iodine. And this apparent discrepancy has lead to many and careful redeterminations of the atomic weight of tellurium. Professor Brauner, indeed, has submitted tellurium to methodical fractionation, with no positive results. All the recent determinations of its atomic weight give practically the same number, 127.7.

Again, there have been almost innumerable attempts to reduce the differences between the atomic weights to regularity, by contriving some formula which will express the numbers which represent the atomic weights, with all their irregularities. Needless to say, such attempts have in no case been successful. Apparent success is always attained at the expense of accuracy, and the numbers reproduced are not those accepted as the true atomic weights. Such attempts, in my opinion, are futile. Still, the human mind does not rest contented in merely chronicling such an irregularity; it strives to understand why such an irregularity should exist. And, in connection with this, there are two matters which call for our consideration. These are: Does some circumstance modify these 'combining proportions' which we term 'atomic weights'? And is there any reason to suppose that we can modify them at our will? Are they true 'constants of Nature' unchangeable, and once for all determined? Or are they constant merely so long as other circumstances, a change in which would modify them, remain unchanged.

In order to understand the real scope of

such questions, it is necessary to consider the relation of the 'atomic weights' to other magnitudes, and especially to the important quantity termed 'energy.'

It is known that energy manifests itself under different forms and that one form of energy is quantitatively convertible into another form, without loss. It is also known that each form of energy is expressible as the product of two factors, one of which has been termed the 'intensity factor,' and the other the 'capacity factor.' Professor Ostwald, in the last edition of his 'Allgemeine Chemie,' classifies some of these forms of energy as follows:

Kinetic energy is the product of Mass into the square of velocity.

Linear energy is the product of Length into force.

Surface energy is the product of Surface into surface tension.

Volume energy is the product of Volume into pressure.

Heat energy is the product of Heat-capacity (entropy) into temperature.

Electrical energy is the product of Electric capacity into potential.

Chemical energy is the product of 'Atomic weight' into affinity.

In each statement of factors, the 'capacity factor' is placed first, and the 'intensity-factor' second.

In considering the 'capacity factors,' it is noticeable that they may be divided into two classes. The two first kinds of energy, kinetic and linear, are *independent of the nature of the material* which is subject to the energy. A mass of lead offers as much resistance to a given force, or, in other words, possesses as great inertia as an equal mass of hydrogen. A mass of iridium, the densest solid, counterbalances an equal mass of lithium, the lightest known solid. On the other hand, surface energy deals with molecules, and not with masses. So does volume energy. The volume energy of two grammes of hydrogen, contained in a vessel of one litre capacity, is equal to that of thirty-two grammes of oxygen at the same temperature and contained in a vessel of equal size. Equal masses of tin and lead have not equal capacity for heat; but 119 grammes of tin has the same capacity as 207 grammes of lead, that is, equal atomic masses have the same heat capacity. The quantity of electricity conveyed through an electrolyte under equal difference of potential is proportional, not to the mass of the dissolved body, but to its equivalent, that is, to some simple fraction of its atomic weight. And the capacity factor of chemical energy is the atomic weight of the substance subjected to the energy. We see, therefore, that while mass or inertia are important adjuncts of kinetic and linear energies all other kinds of energy are connected with atomic weights, either directly or indirectly.

Such considerations draw attention to the fact that quantity of matter (assuming that there exists such a carrier of properties as we term 'matter'.) need not necessarily be measured by its inertia, or by gravitational attraction. In fact, the word 'mass' has two totally distinct significations. Because we adopt the convention to measure quantity of matter by its mass, the word 'mass' has come to denote 'quantity of matter.' But it is open to anyone to measure a quantity of matter by any other of its energy factors. I may, if I choose, state that those quantities of matter which possess equal capacities for heat are equal, or that 'equal numbers of atoms' represent equal quantities of matter. Indeed, we regard the value of material as due rather to what it can do than to its mass; and we buy food, in the main, on an atomic, or, perhaps, a molecular basis, according to its content of albumen. And most articles depend for their value on the amount of food required by the producer or the manufacturer.

The various forms of energy may, there-

fore, be classified as those which can be referred to an 'atomic' factor, and those which possess a 'mass' factor. The former are in the majority. And the periodic law is the bridge between them; as yet, an imperfect connection. For the atomic factors, arranged in the order of their masses, display only a partial regularity. It is undoubtedly one of the main problems of physics and chemistry to solve this mystery. What the solution will be is beyond my power of prophecy; whether it is to be found in the influence of some circumstance on the atomic weights, hitherto regarded as among the most certain 'constants of Nature,' or whether it will turn out that mass and gravitational attraction are influenced by temperature, or by electrical charge, I cannot tell. But that some means will ultimately be found of reconciling these apparent discrepancies, I firmly believe. Such a reconciliation is necessary, whatever view be taken of the nature of the universe and of its mode of action; whatever units we may choose to regard as fundamental among those which lie at our disposal.

In this address I have endeavored to fulfill my promise to combine a little history, a little actuality and a little prophecy. The history belongs to the Old World; I have endeavored to share passing events with the New; and I will ask you to join with me in the hope that much of the prophecy may meet with its fulfilment on this side of the ocean.

William Ramsay.

ADDRESS BY THE PRESIDENT BEFORE THE SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.

In opening the proceedings of this fourth annual meeting of the Society for the Promotion of Engineering Education I wish, first of all, to congratulate the Society upon its great success thus far in accomplishing the object for which it was founded, an object fully expressed in its name. The volumes of its proceedings already published are filled with discussions and the ripe conclusions of the best thought that can be expressed to-day upon many phases of engineering education. No one who desires to become informed upon these matters can afford to neglect these volumes. It is believed that all interested in the object of our Society will find it to their advantage to unite with us.

One striking peculiarity of engineering education seems to me to lie in the fact that it has been determined so largely as to its scope and the lines of its development by the engineering colleges themselves in advance of the formulated demands of the engineering profession and of the public in general, and often, indeed, in opposition to such demands. Through the wisdom and foresight of these organizers of engineering education the profession of engineering has come forth during this generation into public estimation as a learned and responsible profession, quite the peer of law or medicine. This is the work of the engineering colleges, and from the deliberations of this Society it is evident that they still have a large work before them. The educational institutions of our country are in a state of flux. The present movement in education is powerful. These times will be looked back to in future days as those in which mighty educational forces were inaugurated and were adapted to the needs of the nation just as it was coming to its full consciousness as one of the great family of nations, a consciousness of power and responsibility that is causing it to depart somewhat from the revered advice of Washington, which was to keep aloof from European affairs and entanglements with other nations of the earth and work out its own destiny by itself. National growth and our multiplied facilities for communication have greatly modi-

fied our feeling as to this. The triumphs of the engineer in applying steam and electricity are making of one blood all nations of the earth. But the one thing that is making and will make of us a nation worthy of our heritage is our educational life. Our republican institutions, the pride of our early national life, cannot continue such except for the reinforcement and help to come from the enlarged scope of education to-day.

It has seemed to me that I could not, perhaps, use the short time allotted to me for this address better than in trying to summarize some of the thoughts which have appeared in the papers and discussions before this Society, which had its beginning in the Engineering Congress of the Columbian Exposition at Chicago. What I have to say is called forth by the enlarged responsibilities and new conception of the professional position of the engineer of to-day, and the course of study necessary to fit him for the responsibilities of his position.

And, first of all, I think I am right in saying that the demand is growing stronger that courses of engineering instruction shall include nothing else, that is, that they shall be as completely professional in their character as are professional courses in law and medicine.

This demand is not made by the general public, nor to any great extent, I think, by practicioners in the engineering profession. These are greatly impressed with the necessity the engineer has for general culture, and rightly so. The demand is one made by the engineering colleges themselves. At present the curriculum of our average engineering college includes from 20 to 25 per cent. of culture studies, such as English, French and German; from 30 to 25 per cent. of indirectly technical study, as Mathematics, Physics, etc.; and 50 per cent. of directly technical study.

The culture studies are of fundamental importance to the engineer. He usually obtains far too small an amount of such study before graduation. He finds himself poorly fitted in this respect for his subsequent career. His preparation in the use of language for writing and speaking has been too meager. He finds that his professional work is not of a character to supplement his education in this particular. Yet culture studies are out of place in any engineering course with strongly marked technical tendencies. Both student and instructor feel this. The two kinds of study interfere with each other. The student cannot fix his attention on culture study while absorbed in the beginnings of technical study. The instructor in the culture studies feels the hopelessness of the task and must perforce be content with a lifeless, memoriter fulfilment of task work. The instructors in the technical studies are apt to be impatient at the time and attention demanded by the culture studies as more or less of an obstacle and hindrance to what is rightly regarded as the student's main work.

Under such circumstances as these it seems clear that the culture studies must soon disappear from our engineering courses. This change will, doubtless, come about gradually and will occur in the more fully developed courses first. It will not mean that culture studies shall be omitted from the education of the engineer. It will simply mean that he must obtain them outside of the engineering course, preferably before he enters it. The tendency, on every hand, is to insist more strongly than heretofore upon the culture studies as essential to the engineer. To insure large success he must be a man of broad culture. He is to direct large enterprises as well as plan the necessary structure and machinery of the plant, and that man will succeed who by the influence of his personality, with

tongue and pen, shows himself able to hold his position as the peer of other great organizers of our industrial life. The highest success is to be quickly reached as a rule only by those engineers who have had adequate preliminary education in culture studies, which is another name for the liberal arts. Such culture is now most readily and suitably attained by pursuing some part, more or less complete, of a regular college course. This will come to be regarded more and more as the best preparation for a professional course in engineering, as it is now for a professional course in law and medicine.

Following the consideration of the culture studies comes that of the indirectly technical studies, such as mathematics, mechanics, physics, chemistry and drawing, which at the present time occupy between one-third and one-fourth of the time of the average engineering course. These studies rightfully have place in the course, but the question whether the amount and quality of the work at present accomplished is entirely satisfactory is one which has been much debated. It may be said fairly, I think, that the standard of work in mathematics, mechanics and physics has been gradually but surely advancing in all the engineering colleges, against the opposition of a large part of those engaged in engineering practice, who have been largely opposed to teaching more mathematics, etc., than they themselves were taught, saying that they have had no use for much of that which was taught them. This argument has seemed perfectly conclusive to those who have advanced it, and also to the student, who naturally finds such studies hard, and (as he thinks) much in the way of his rapidly advancing to purely technical study. This view has also often met acceptance with the technical professors, who are largely in sympathy with those engaged in practice. But the argument is fallacious, as I am convinced. The contrary view has prevailed in the papers before this Society. We are to look upon this gradual advance of the standard in mathematics, etc., as a movement which has not as yet ceased, but one still in progress.

Perhaps the point of greatest difficulty, so far as mathematics is concerned, has been to have the differential and integral calculus so incorporated into the engineering courses as to really become part of the working equipment of the student. That may not have been completely accomplished as yet, but that is the standard now regarded as essential, and one which is more and more nearly attained year by year. It is my opinion that it will not be satisfactorily reached until the course in calculus includes the treatment of differential equations. This conclusion is forced upon me, not merely by the abstract consideration that physical and mechanical questions find their expression best by the use of differential equations; but the problems arising just now in the theory of alternating currents must evidently be treated on the basis of their differential equations. Heretofore it has been possible to satisfy the student as to the treatment and solution of the mechanical and physical problems in his course without special study of differential equations, though he was likely to meet a number of points that were puzzling and unsatisfactory by reason of his ignorance of that subject. But now the matter can no longer be avoided, I think, as no other treatment can give the necessary insight into the complicated phenomena which must be fully mastered to-day by the student in electricity.

Mechanics, too, and physics have taken on a larger and larger significance. The principles of mechanics underlie all physical phenomena and all engineering processes. Their formal study has been found to be of increasing importance in under-

standing the strength and resistance of materials, the thermodynamics of steam- and gas-engines, turbines, electrical generators, motors and transformers.

As to physics and chemistry it is unnecessary for me to explain how small are the opportunities compared with what is desirable. The state of knowledge in these sciences is steadily advancing. Hertz waves and Röntgen rays are meeting technical applications, and new knowledge must have place. The field constantly increases. More time must be taken for such subjects. We cannot escape it. It seems impracticable to secure it by having more physics and chemistry taught in the preparatory schools. Such work is not satisfactory. It is preferable to relegate more of the pure mathematics to those schools.

We are to look in the future, as I think, for an increase in the amount and an improvement in the quality of the work in all that part of the work in our engineering courses, which, though but indirectly technical, affords the theoretical basis of the strictly technical studies of the course.

The improvement in the quality of the instruction will lie, for one thing, along the line of the illustrations and problems employed, in seeing to it that they have to do with things tangible and in the direction of practice. This will help secure the necessary interest in theory and make it, as it should be, the basis of practice.

We now come to the consideration of those studies which are strictly and directly technical. They occupy in most engineering courses at least one half of the course. The improvements which have taken place in engineering courses have occurred more largely in this part of the work than elsewhere, but great divergence of opinion has naturally arisen as to what is best. In certain courses of mechanical engineering an excessive amount of manual training and shop work was at first introduced; inexpert opinion still lays undue emphasis upon this part of the course in mechanical and electrical engineering. But as the true function of manual training and trades schools comes to be better understood, and their value to the community in developing handicraft and in furnishing education to the artisan as distinguished from the professional engineer, not only will such schools be well supported and greatly increased in number, but they will be sharply distinguished in the minds of all from the engineering colleges. These last are not intended to make skilled workmen, though some seem still to think so. The engineering student needs a comparatively small amount of practice in wood working, which shall be especially directed toward pattern making; a short experience in the blacksmith shop and foundry, and somewhat more of metal working by hand and machine tools, together with the management of boilers and steam engines. But any effort to make prolonged exercises in these subjects take the place of more theoretical study in an endeavor to make a workman or a foreman instead of an engineer.

The same is true of extended civil engineering field practice with instruments. It is quite possible to put too great emphasis upon it and consume more time with it than the study warrants. The temptation to do that is strong. It must be remembered, however, that surveying is not today the principal occupation of most engineers. The plan of putting shop practice, field work and other like practical parts of the course into the long vacations has much in its favor and seems to be coming more into vogue. The student should graduate from the shop and the surveying corps as soon as he has obtained a moderately good acquaintance with tools and processes and enter the testing laboratory. That is the true field for extended practical work in

the engineering course. In it the work should be arranged with regular sets of graded exercises covering the measurement, proper records and working out the results of tests on all the materials and processes treated in the theoretical work of the student as well as whatever he is likely to encounter in practice or inspection. It is only by prolonged drill in testing that he can acquire the necessary basis for that professional and practical judgment which will make his opinion of value. While thus insisting on testing laboratories as the best and most important recent development of our engineering colleges as well as one of the most costly parts of them, it is needful to insist at the same time and with still greater emphasis on the paramount importance of the theoretic instruction in the mathematical, mechanical and scientific principles which should furnish the core of every engineering course. This it is which engineering colleges must teach and trades schools may entirely omit. Engineering colleges may leave out shops and laboratories, and some do so; they may omit culture studies, and have very imperfect instruction in drawing and design, without forfeiting the claim to give engineering courses of considerable value; but no engineering college can afford, at the risk of imperilling its reputation and usefulness, to neglect or slight, for any length of time, to put forth its best efforts to thoroughly indoctrinate its students in as complete and extended a theoretical treatment of the engineering subjects it teaches as the time at its disposal and the preparation of its students will permit. Drawing and designing, shop practice and testing, general culture and professional information, all are subsidiary and auxiliary to this one thing. Engineering courses at first began with little else in them of importance to the profession than this, and by it they have proved themselves indispensable to it. It is a mistake too frequently made by practitioners, deeply immersed in the details of their profession, to suppose that the most important and fruitful field of instruction is not just here.

Practice, experience, judgment will come in time to the young engineer even if he should not have it before graduation, but study and theory he will not usually thus attain to. That must be had before graduation or the engineering college has little excuse for existence.

This being granted, the fact still remains that the ultimate success of the engineer as a professional man depends upon his character and force as a man among men, upon his culture, upon his integrity, upon his tact and social power. In other professions such qualities receive continuous culture in the practice of the profession. It is far less so with the engineer. Here, then, is an argument for broad preliminary culture before entering upon engineering study, but it likewise points to something with which the engineering colleges have thus far not busied themselves to any appreciable extent, but which in the future cannot be neglected in justice to the position which the profession is called to occupy. Every engineering student has the right to careful instruction in a recognized code of professional ethics which shall instruct his conscience and fortify his will, and give him a satisfying consciousness of duty done to his professional brethren, to the public and to the judge of all the earth.

Until such instruction shall take its place in our engineering courses the public can never rely upon organized professional opinion to restrain unprofessional conduct, nor can individual members of the profession be sustained in courses of right action against the demands of corporations and combinations of capital. It remains, then, for engineering colleges to help organize the profession and to furnish the basis of such

organization in a code of professional ethics which shall be worthy, unifying and elevating.

One step further in this direction is also of importance, namely: Provision for such instruction in the law of contracts as will enable the engineer to discharge with confidence his professional obligations and protect the interests of his employers. For, it is not only necessary that he should have the scientific and technical knowledge to adapt the forces of nature to the projects in view, and exercise good judgment as to the best means of doing this, as well as have the ability fully and clearly to set forth his plans in a manner to carry conviction to those seeking his services; but it is also equally necessary that when entrusted with the responsibilities of actual construction he should be able so clearly and explicitly to set forth the rights and obligations of all parties, that disputes and legal difficulties may not arise, such as often are more costly and troublesome than errors of design. The place to obtain the necessary legal knowledge of specifications and contracts is during the professional engineering course.

It has been urged by some that economic design, as dependent upon the market price of materials, labor and power, should also find place in the engineering course, but the consensus of best opinion seems to draw the line here between education and practice. While the attention of the student should undoubtedly be drawn briefly, yet pointedly, to the economic limitations under which commercial work is done, the attempt to make designs under such limitations should be mostly left to the time when judgment has ripened and the complex conditions of practice are better known by experience. In fact, almost no undergraduate work can usefully reproduce competitive conditions, and the attempt to do this must usually be regarded with distrust. The aim of teaching is not an object lesson under business conditions, but thorough instruction in underlying principles, especially those theoretical and scientific principles which cannot be correctly estimated by the layman.

It will be noticed, in all the matters in which I have attempted to reflect the opinions which are current in the papers that have been presented to this Society and published in its proceedings, the movement and tendencies which I have sketched can be traced, all of them, to a single source, namely, to the position of influence and responsibility which the professional engineer has but recently come to occupy. That position is what it is to-day in the esteem and respect of the public largely through the wise efforts of the managers and instructors of the engineering colleges. Their work in moulding and directing the engineering education in the future will, I am persuaded, be no less important than in the past. That such guidance shall continue to be wise, its progress healthful, and costly mistakes be avoided, will be materially assisted by the deliberations and discussions of this Society.

The valuable report of the committee on entrance requirements, now in your hands, is an important piece of work, taking rank beside the other great educational reports upon the various phases of secondary education which have attracted such general attention during a few years past and have influenced so greatly the work of the preparatory schools as well as the requirements of the colleges.

I regard it as a happy omen that we are met to hold this meeting so early in our history here in Toronto, thereby expressing our interest in the promotion of engineering education as a branch of applied science, confined by no geographical boundaries or limitations, as well as our conviction that some of the most vital elements of human

progress will be moulded by the conclusions we shall reach. Let us address ourselves to the work before us with the same fraternal zeal that has characterized the meetings of the Society in the past, and that in fact is singularly characteristic of that noble body of men who practice the profession of engineering, a profession whose triumphs are our pride and whose future greatness it is the object of this Society to foster.

Henry T. Eddy.
University of Minnesota.

ANTHROPOLOGY AT THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The section was organized August 9th, as follows: W J McGee, Chairman; Anita Newcomb McGee, M. D., Secretary (elected to fill the vacancy caused by the resignation of Harlan I. Smith); W. H. Holmes, Councillor; Alice C. Fletcher (*ex officio*), M. H. Saville, Frank Hamilton Cushing and Warren K. Moorehead, Sectional Committee-at-Large; Washington Matthews, General Nominating Committee; Lightner Witmer, Stephen D. Peet and Alois Hrdlicka, Nominating Committee-at-Large.

The meetings of the section were held in the most spacious of the class-rooms in the high school building, and were well attended not only by members of the Association, but by citizens of Detroit; the attendance ranged from 50 to 400, averaging fully 200. Special interest attached to the afternoon session of August 11th, which was a joint meeting of Sections E and H, in the room assigned to the latter, for discussion of the human relics from sand deposits in Delaware valley. A number of foreign guests, members of the British Association, attended this and other meetings of the section; among them were Dr. and Mrs. Robert Munro, of Edinburgh; Professor and Mrs. J. L. Myres, of Oxford; Prince Krapotkin, of Russia, latterly of Kent, England; Dr. Albrecht Penck, of Vienna; Professor Vernon Harcourt, of Oxford, and Dr. H. P. Truell, of Wicklow, Ireland.

The afternoon of August 9th was devoted to the Vice-Presidential address, which has appeared in this Journal; and the morning session of August 10th was devoted mainly to a summary and continuation of the address, followed by a general discussion of the anthropologic classification suggested therein, in which Miss Fletcher, Dr. Munro, Professor Myres, Dr. Peet, Professor Witmer and others participated. Later a report was presented by Miss Fletcher on the Winter Conference of members of Section H held in New York last December. The section then voted to request authority from the Council to hold a formal meeting at Ithaca during the Christmas holidays of this year. (This meeting was duly authorized by the Council, and a small appropriation was made to cover cost of printing announcements, etc.)

The reading of the papers began with the afternoon session of August 10th. The first of these was an elaborate account of the superstitions, beliefs and practices of the ancient Mexicans, by Zelia Nuttall, read, in the absence of the author, by Dr. Saville. The material was mainly compiled from the records of early Spanish missionaries among the Aztecan Indians; it derived importance from the fact that these records are little known, and have not hitherto been brought to the attention of students of anthropology. The discussion by Dr. Hrdlicka and others indicated that many of the superstitions and ceremonies of the ancient Mexicans are duplicated among the more primitive peoples of different countries, notably those of central Europe.

'The Study of Ceremony,' by Dr. Washington Matthews, followed. The author expressed the conviction that the ceremonies

of primitive people are not merely worthy of scientific study, but are of sufficient extent and importance to serve as a basis for a distinct branch of science; and he illustrated his idea by describing the elaborate ceremonies of different Indian tribes and discussing the rise and decadence of fiducial practices among the American aborigines. He suggested several terms suitable for designating the study of ceremony, and invited the appointment of a sectional committee to consider the subject of nomenclature. After discussion of the paper by Dr. Peet and others, the section voted to appoint the committee suggested by Dr. Matthews, and Rev. Stephen D. Peet, Miss Alice Fletcher and Mr. Frank Hamilton Cushing were appointed as such committee.

Dr. Peet followed with a suggestive comparison of Cherokee and European symbolism, in which many curious parallels were brought out.

The next communication was 'Koreshanity: A Latter-Day Cult,' by Anita Newcomb McGee, M.D. The author described briefly a cult or religious system founded by Dr. Cyrus R. Teed, or Koresh (the Hebrew form of the prename Cyrus), and detailed the curious cosmogony bound up with the religious teaching. Although it gained foothold only within a dozen years, the doctrine has spread with such rapidity that the adherents number many hundred, perhaps thousands, of whom about 150 have entered a communistic organization with headquarters in Chicago and a colony in southwestern Florida. The communication was discussed by Professor Morse, Professor Witmer and others.

The work of the day ended with a paper on the origin of the week and holy day among primitive peoples, by Rev. R. J. Floody. Beginning with an account of the wide distribution of hebdomadal systems in different parts of the world, the author passed to explanations of the occurrence of such systems, and finally enunciated the proposition that such systems originated spontaneously among peoples in that culture-stage in which adoration of the sun, moon, etc., prevails; he held that the lunation of about 28 days is the simplest and most convenient time-measure longer than the day, and that it is naturally divisible, first into semi-lunations of relative dark and light, and then into quarter lunations defined by wax and wane with respect to full moon, 'dead' moon and intermediate half moon. An elaborate array of evidence in support of the idea, derived from primitive customs and also from folk-lore and even modern customs, was presented, and the easy development of the sacred day in connection with the moon-defined seven-day period was pointed out.

The morning session of August 11th was devoted to Mexican archæology. The first paper was a brief account, by Professor F. W. Putnam, of recent researches by George Byron Gordon on the banks of the Ulloa River in Honduras, made for the Peabody Museum. Professor W. H. Holmes followed with an account of 'The Building of a Zapotec City,' in which he sketched briefly the history of the ruined city of Mitla, as viewed from the standpoint of the builder's art. He illustrated the subject by selecting an ordinary edifice and describing the several stages in construction, beginning with the preparation of the material by quarrying and cutting the stone, passing to the masonry construction and then describing the roofing and surface embellishment; examples of the materials and of the quarrying and cutting implements—almost wholly of stone—were exhibited. Dr. Saville then noted 'The Geographic Distribution of a Certain Kind of Pottery found in Mexico and Central America;' this ware is characterized by a peculiar steel blue-gray lustre, more nearly approaching a true glaze than any surface finish heretofore

known in ancient America, of which twenty-six specimens have been found in widely separated localities from Tapec, Mexico, to Copan, Honduras; he expressed the opinion that the specimens were originally made about Alta Very Paz, Guatemala. Dr. Peet then discussed 'The Serpent Symbol in Nicaraugua,' noting the great contrast with the corresponding symbol found in the eastern part of the continent, and pointing out that in the East the serpent was generally regarded as evil or inimical to mankind, while in Nicaraugua it was considered a beneficent deity. The reasons for this diversity in belief were examined at length, and reference was made to the serpent symbol and its meaning in other parts of the world. The author expressed the conviction that, while the theory of parallel development (*i. e.*, the doctrine of activital coincidence, which has recently grown prominent, especially among American anthropologists) was strongly suggested by the facts, it could hardly be accepted as a full explanation of the similarities and dissimilarities noted. The paper was discussed by several members, notably Dr. Munro, who expressed some skepticism concerning the prevalence of serpent worship and mentioned instances of manifest error in the interpretation of artificial and even natural objects as serpent symbols. Mr. Stansbury Hagar contributed remarks concerning the Micmac and other Indians.

The afternoon was devoted to a symposium on the question of early man in Delaware valley. The Section of Geology (under Professor E. W. Claypole as Vice-President) participated. Brief papers by Messrs. H. B. Kümmel and G. G. Knapp were first presented, in the absence of the authors, by Professor R. D. Salisbury. Professor Putnam then gave a detailed account (illustrated by numerous diagrams, photographs and specimens) of the work of his assistant, Mr. Ernest Volk, in searching for human relics in the deposits about Trenton, New Jersey. It was shown that there is here a relic-bearing deposit of sand containing ferruginous bands, ranging from two feet or less to three or four feet in thickness; and photographs and other records were exhibited, showing the occurrence of artificial chips, spalls, flakes, and more or less perfect implements of argillite, quartz, etc., in this deposit to the depth of nearly or quite three feet, the abundance diminishing downward. Professor Putnam especially pointed out that, so far as his observations had gone, the artifacts of argillite predominate below, those of other materials above; he also held that these argillite objects were of the type known in Europe as paleolithic, while he regarded the more superficial artifacts as neolithic. He was followed by Professor G. F. Wright, who argued (1) that the ferruginous bands in the sand are marks of stratification, hence (2) that the deposit is water-laid, and (3) that its age corresponds with that of the later glacial deposits further northward in Delaware valley, *i. e.*, that it is Pleistocene.

Professor Holmes then exhibited a series of diagrams and other illustrations representing the geographic and geologic conditions of the relic-bearing deposits about Trenton. He first described the extensive deposit or series of deposits, reaching forty feet or more in thickness and consisting of gravel with some loam, which were undoubtedly formed during the glacial period. He pointed out that these were the deposits from which human relics were first reported at Trenton, and dwelt on the extended researches of over a dozen skilled archæologists and geologists who had been unable to find artifacts in undisturbed portions of these deposits, though they were found in the talus which unskilled observers sometimes mistook for the undisturbed deposits; and on this body of negative, yet abundant and cumulative, evidence he ex-

cluded these older deposits from consideration in connection with the question at issue. Taking up the later sand deposit, he showed that it is superficial and of limited extent, and of so slight depth as not to preclude the probability that all of the artificial material might have worked its way down from the surface; he also pointed out that this deposit appears to rest unconformably on the Pleistocene deposits, and gives other indications of being much newer. Passing then to the distribution of objects and materials, he showed that the artifacts diminish gradually and with fair uniformity downward, the distribution following the law displayed by organic matter and other substances originating at the surface; he also noted that his observations and those of his collaborators indicate no perceptible difference in frequency of argillite and other materials at the surface and at the greater depths, and exhibited photographs and specimens showing the occurrence of a finished quartz blade at about the maximum depth of human relics. In his introductory remarks and incidentally later he pointed out that, whether the artifacts be regarded as paleolithic or neolithic, they are precisely such as were found in use among the Algonquian Indians living on the site up to the time of white settlement. A brief paper by Thomas Wilson was read, in the absence of the author; it was chiefly an expression of conviction that a part of the argillite material should be classed as paleolithic.

Speaking on behalf of the geologists, Professor Claypole discussed the processes of ferrugination, and pointed out that the ferruginous bands illustrated in the diagrams and photographs could not be regarded as stratification lines, or as evidence of the aqueous origin of the sand-beds. Professor Salisbury, the geologist in charge of the State and Federal Surveys in the district, then discussed the geologic relations of the deposits; he described the thick beds of gravel and loam (which he had examined repeatedly without finding artificial material) as aqueo-glacial in origin and hence Pleistocene, and observed that the local and superficial bed of sand is younger, and was probably formed after the present river channel was excavated, at least in part, in the older deposits; he held that there was no decisive evidence that these sands were water-laid, that all of their phenomena could be explained otherwise, and that it was at least equally probable that they are eolian and perhaps quite recent. Professor T. C. Chamberlain emphasized the uncertainty as to the origin and age of the deposits developed by the elaborate studies of Salisbury, Kümmel, Knapp and others, and counseled caution in basing sweeping conclusions on so questionable premises. Dr. Penck described a somewhat parallel case in Europe, in which the question as to the age of relic-bearing deposits was set at rest by the finding of Roman objects associated with the artifacts of stone. Dr. Munro questioned whether any of the objects exhibited were paleolithic in the sense in which that term is used in Europe, and expressed doubt as to whether any trustworthy evidence of paleolithic man has been found west of the Atlantic. In response to a call, Mr. G. K. Gilbert questioned the validity of the supposed evidence of paleolithic man in Delaware valley, and mentioned cases coming under his own observation in which natural and artificial material was commingled in recent deposits.

Rising in rejoinder, Professor Putnam alluded to the discovery of an artifact beneath a large bowlder, apparently in place in the older gravels, and mentioned the finding of a human cranium, apparently of Eskimoan type, in the same deposit; and he reiterated his confidence in the prevalence of argillite materials of paleolithic character in the basal layers of the sand

beds. Professor Salisbury reviewed the geologic discussion, pointing out that the relations were such that, if the objects under consideration were fossils, no geologist would think of regarding the association as significant; and Professor Holmes recalled attention to the fact that the argillite artifacts are indistinguishable from those produced by Indians living in that vicinity up to the beginning of the present century.

The symposium was notable for the thorough knowledge of the facts displayed by several participants, as well as for the courtesy with which it was conducted.

The morning session of August 12th was opened with the exhibition of an archæologic map of Ohio by Warren K. Moorehead, who described the methods pursued in his archæologic survey of the State. The map received favorable comment throughout the section as representing the most ambitious and successful work of the kind thus far undertaken in America. The next paper, 'The Import of the Totem—a Study of the Omaha Tribe,' by Miss Alice Fletcher, was a reremarkably full yet concise memoir representing the results of thorough study. It was favorably discussed by Dr. Matthews, Dr. Peet, Professor Myers and others (it will appear elsewhere in this Journal).

The afternoon session commenced with two elaborate papers illustrated by photographs, on the Tagbanua and the Mangyan tribes of the Phillipines, by Professor Dean C. Worcester; the tribes being discussed separately by reason of important differences in their customs and beliefs. Their physical characteristics, their marriage and mortuary customs, their arts and industries and their beliefs were described in detail. Then came a full account of the anthropologic work of the New York Pathological Institute, by Dr. Hrdlicka, the Superintendent. The chief object of this work is the establishment of average or normal standards, physical, physiologic and psychologic, especially of American-born people; the methods or ancillary purposes were fully set forth and the value of the work was shown. This paper was followed by two suggestive papers by Harlan I. Smith, viz.: 'The Ethnologic Arrangement of Archæologic Material,' and 'Popular Anthropology in Museums,' read, in the absence of the author, by Dr. Saville.

On August 13th the session was opened by an attractive paper, illustrated by numerous diagrams and tables, entitled 'An Experimental Analysis of the Relations of Rate of Movement to certain other Mental and Physical Processes,' by Dr. Lightner Witmer. The results of the investigations described were full and far-reaching, and will doubtless be presented in some detail elsewhere. There followed 'A Statistical Study of Eminent Men,' by Professor J. McKeen Cattell; it was presented by the Chairman in the absence of the author. It involved the application of a somewhat arbitrary method of measuring eminence quantitatively on the basis of the space devoted to individual biographies in certain selected encyclopedias and biographical dictionaries; and, after finding the thousand most eminent men of the world in this manner, their distribution was discussed by time, race, nation, etc. The results were illustrated by diagrams. The paper was freely discussed by several members. 'A Case of Trephining in Northwestern Mexico,' by Carl Lumholtz, was presented, in the absence of the author, by Dr. Hrdlicka; it was deemed specially noteworthy as one of the most northerly examples thus far known of a primitive art which attained great development in Peru; and also because of the suggestion, derived from the form of aperture, that the operation was performed by tubular drilling something after the fashion pursued in the modern operation. The next communication was 'A Description of a Pre-Aztec Skeleton found

in Adobe Deposits in the Valley of Mexico,' by Dr. Lumholtz and Dr. Hrdlicka; it was presented by the junior author, and illustrated by photographs, diagrams and tables. The skeleton presents several remarkable features which were described in detail; in general it is of strikingly low somatic type. The characters, particularly of the skull, differ from those of the Aztec or Nahuatlan and approach those of other ancient inhabitants of the same valley, especially the so-called Toltecs. The paper was discussed at length by Dr. Matthews, Professor Morse and others, the former pointing out, by reference to many examples, the general fact that supposedly low somatic characters frequently result from the form of exercise determined by the habits of life of certain tribes; he referred especially to the olecranon perforation, which he ascribes to the custom of grinding on the metate. Several papers were then read by title, and the scientific work of the section was brought to a close by a highly suggestive communication on 'The Genesis of Implement Making,' by Frank Hamilton Cushing, which will appear elsewhere in this JOURNAL.

The session was brought to an end within the last minute of the time allotted to the sectional work at the Detroit meeting, every moment of the working time having been occupied. In a vote of thanks to the presiding officer of the section, courteously presented by Miss Fletcher, special reference was made to this activity; and in seconding the motion, ex-President Morse observed that, during the many years of his connection with the Association, he had never seen the sectional work performed with so great harmony and scientific zest.

ANITA NEWCOMB MCGEE, *Secretary.*

COLUMBIA UNIVERSITY ZOOLOGICAL EXPEDITION OF 1897.

THE results obtained by the zoological expedition sent out by Columbia University in the summer of 1896 were so valuable as to warrant a second expedition to continue the examination of the waters of the northwest Pacific coast. It was decided this year to carry the exploration to Alaska and to examine new regions on Puget Sound, in the vicinity of Port Townsend.

As before, the party obtained the most satisfactory rates from the Canadian Pacific Railroad, and it gives me great pleasure to say that the magnificence and grandeur of the scenery along the route is not the only recommendation for the road. The great care taken for the safety of their passengers, together with many courtesies and polite attentions which we received from every official with whom we came in contact, added greatly to the pleasures of the trip.

I also take this occasion to thank Lieutenant Hetherington, U. S. N., of the Bremerton Naval Station, for many courtesies shown us both before and after our arrival at Port Orchard.

The original members of the party were G. N. Calkins (in charge), N. R. Harrington, B. B. Griffin, J. H. McGregor and F. P. Keppel. Professor E. B. Wilson and Professor F. E. Lloyd joined the party somewhat later. We reached Port Townsend, which again was to be our headquarters, on the morning of June 16th. There was little to be done at this time, for our experience last year had shown that few of the marine forms were ripe so early in the season. We added a few new species, however, to our collection of last year; among them were three siphonophores (*Monophyes*, *Diphyes* and *Physophora*); one ctenophore (Beroë); five medusæ, one nudibranch mollusc; one turbellarian, a lizard and a snake, but our attention was turned mostly towards our anticipated excursions to Port Orchard, to Sitka, Alaska, and to Neah Bay. Owing to the lateness of the maturation-period in the cold waters

of Puget Sound, we decided to go to Alaska as soon as possible and to stay there as long as favorable results could be expected. We looked forward to this trip with great expectations, for every one had spoken of the richness of the fauna in Sitka harbor, where the water is more shallow than in Puget Sound and from six to ten degrees warmer. Furthermore, through the kind agency of Captain Young, of the Marine Barracks at Sitka, Captain Symonds, of the warship 'Pinta,' had offered us the use of one of the Pinta's steam launches for dredging purposes. Everything, therefore, seemed more favorable for good collecting than at Port Townsend.

In the meantime the excursion to Port Orchard was planned and executed. Port Orchard lies across Puget Sound from Seattle and consists of several bays connected by deep channels of swiftly running water characteristic of this inland sea. In some of the pockets in these bays the tides are so little felt that the water is practically still and considerably warmer than the outer waters.

The swift water of the channels promised good dredging, but unfortunately we took with us our lightest dredge which was practically useless in the current; one fine brachiopod (*Terebratulina*) alone could hardly console us in our disappointment. The best results were obtained on shore, where Mr. Griffin found quantities of *Tychodera* (a genus of Enteropneusta), while hydroids of many kinds were as characteristic as their absence at Port Townsend. We left Port Orchard with the intention of returning in August, when, with a heavier dredge, we might expect better results.

The trip to Sitka offered few chances for zoological work. Happening to reach Fort Wrangle, however, at low tide, two of the party found a number of fine specimens of *Echiurus*, a form which we had not found in Puget Sound. On a previous trip to Alaska, Mr. Calkins had found a large number of ice worms (*Dendrobœna*) on the top of Muir Glacier. Although these interesting forms have been repeatedly described, this is the first time they had been found on the Alaska glaciers. They were most numerous in the clear water of pools in hollows of the ice, although in many cases they were found deeply imbedded in the solid ice, which had to be shaved down before the animals could be reached. This year the ascent of the glacier was not only extremely difficult, but, owing to the disappearance of the ice bridge, it was impossible to get on the top of the clear ice as last year. We accordingly found comparatively few ice worms.

We reached Sitka July 14th, with the loss of one package of collecting tools, which had been dropped overboard at Port Townsend during careless handling of the freight. These tools were fished out and sent to us by the next boat. A small house by the water was soon fitted with shelves and made into a somewhat cramped but convenient laboratory. We were much disappointed to find that the 'Pinta,' having been ordered south to the repair shops, had indeed left her steam launches, but with no one to run them. There was no other steam launch available, and all dredging, therefore, had to be abandoned, save such as could be ineffectually done with a sail boat. This deprivation was much more serious than any we had yet encountered, for we soon found that Sitka harbor itself is poorly adapted for good dredging, having an extremely rough, rocky bottom. The good dredging grounds, *i. e.*, bays with sandy bottoms, such as Silver Bay, Crab Bay, etc., were too far away to be reached by sail boat, although a launch could have made the round trip comfortably in one day. We were thus forced to confine our attention to low-water collecting. In this we were very successful. The tides ran out for a considerable distance, leaving

great stretches of rock and sand exposed. The most striking thing in regard to these rocks was the richness of many-hued sponges, of Bryozoa covering rocks and weeds with fleshy or encrusting colonies; while under the rocks, in addition to the usual crabs, star-fish and annelids, rarer forms of nemerteans, echiurids and sipunculids were frequently found. The small patches of sand and shell between the rocks contained quantities of gigantic *Nepthys*, *Amphitrite*, *Synapta* and sand anemones, while in certain regions groups of *Edwardsia*, lamellibranchs and various annelids might be dug up.

On the numerous rocky islands which abound in Sitka harbor we found great numbers of sea urchins, the large *Sphærechinus* in particular, which were neatly dissected for us by the noisy ravens whenever left in the tide pools. Here, too, were found many kinds of actinians, *Thysanurans* in abundance, and various hydroids. Under the wharf and on the piles were great forests of campanularian hydroids ensnaring quantities of copepods, nematodes, nudibranch molluscs and infusoria; while on them, as parasites, gigantic acinetans were abundant. Smaller single hydroids living on mollusc shells and on the piles were added to our collections, while an occasional holothurian (*H. Californica*) might be fished out with a long pole. Professor Wilson and Mr. Harrington found this echinoderm in great abundance on a sandy bottom at Redoubt, some twelve miles from Sitka, and in them an occasional *Entoconcha*.

The rocks under the wharf were carpeted with a thick velvet of Bryozoa, chiefly *Alcyonidiidæ*, *Cellulariidæ* and *Diastoporidæ*, and many different genera were well represented. Medusæ were abundant near the shores among the eel grasses and kelp. These were chiefly anthomedusæ and leptomedusæ, although *Haliclystus*, of the order stauromedusæ was occasionally found. The 'Elbowed' medusa described by Agassiz was especially abundant, while *Polyorchis cœruleus*, scyphomedusæ and several different species of *Thaumantias* were less numerous. Large specimens of *Salpa* sometimes drifted in from the Pacific, but ascidians were less numerous than at Port Townsend.

One of the most attractive methods of collecting at Sitka was by skimming; here, at high water, the tow was wonderfully rich, a single pipette full of the sediment from one tow was found to contain quantities of pteropod larvæ, the *Mitraria* larva of Metschnikoff, the *Actinotrocha* larva, *Polygordius* trochophores, a great species of *Appendicularia*, Pilidium larvæ, a pelagic rhabdocoel turbellarian, Auricularian and Bipinnarian larvæ, etc.

The collection and preservation of these interesting and often rare forms was not the only line of research. Cytological material for many different investigations was preserved. This included a series of maturation and fertilization stages of *Sphærechinus*, maturation and fertilization of *Edwardsia*, maturation material of *Thaumantias*, material for spermatogenesis of *Nepthys*, a full set of material for the development of medusa buds of *Plumularia*, maturation material of *Echiurus*, of *Holothuria*, maturation and fertilization of eggs of a lamellibranch, growth and embryological material of a tunicate, etc. In addition to this, notes were kept on the distribution of forms on rocks, piles or pelagic, and of course many notes on the habits, appearance and movements of the living animals.

Taking all into consideration, however, we are forced to the conclusion that, for shore collecting at least, Sitka is less favored than Port Townsend, where the great stretches of tide flats, shaded by long lines of wharves with innumerable piles, offer advantages for shore collecting hardly to be

surpassed. What our impression of Sitka might have been had we had the use of a launch for dredging can only be inferred; from the nature of the littoral fauna and from the pelagic forms it seems as though we might have found great richness at depths from five to twenty fathoms.

Owing to our limited resources for collecting at Sitka, and to the desire to get back to Puget Sound in time for embryological investigations, we decided to return to Port Townsend at the end of three weeks. Here we were met by an unforeseen difficulty. It was in the very midst of the tourist season, and in addition to the usual tourists many Christian Endeavorers had taken the opportunity to visit Alaska. The result was that the regular boats were overcrowded, and our only chance of getting away at the time desired was on some steamer coming north with miners and returning light. Such a chance was offered by the 'Mexico,' an extra boat put on to meet the rush to the Klondike. The 'Mexico' arrived at Sitka August 3d, after leaving about 300 miners at Skaguay and Dyea, and, as anticipated, she was practically empty for the return trip.

The captain of the 'Mexico,' who had lost time on the trip north, wanted to save time on the return trip, and decided to take the outside passage from Sitka, thereby saving sixteen hours on the usual time of the inside passage. It was the intention at first to enter the inside passage north of Mary Island, but later it was decided to run down to Dixon Entrance before leaving the open Pacific. We reached the entrance about midnight, but a light fog had settled, and for some hours the pilot caused the vessel to beat around at half speed or else to lie quiet. The water was too deep to anchor, and the effect of the strong currents on the vessel's course was not properly reckoned, for at four o'clock in the morning of August 5th the order was given to go ahead at full speed, and twenty minutes later the 'Mexico' crashed into West Devil Rock, a charted rock some distance (3–7 miles) out of the regular course. The hole made in the bottom of the vessel was beyond question of repair, and at 6.30 a. m. she sank out of sight in 500 feet of water.

After eighteen or twenty hours in the open boats the passengers were landed at the Indian village of New Metlahkatlah, where they were taken care of by the Indians and their chief, Father Duncan, until the 'Topeka' called for them, two days later, and carried them back to Puget Sound. Nothing was saved but the hand baggage; most of the instruments and all of our scientific material, reagents, notes, books and theses, representing not alone the summer's work, but unfortunately also much work of the previous year, now lie at the bottom of Dixon Entrance.

Without reagents and instruments and feeling more or less upset by the shock of the wreck, the entire party found it difficult to settle down again for work. A few dredging trips, however, enabled Mr. Harrington to renew his supply of *Entoconcha*, while turbellaria, molluscs and some cœlenterates were found in full maturity. The party soon broke up, and the material collected at Port Townsend and Port Orchard alone represents the work of the expedition of 1897.

GARY N. CALKINS.

*MIMICRY IN BUTTERFLIES OF THE GENUS HYPOLIMNAS AND ITS BEARING ON OLDER AND MORE RECENT THEORIES OF MIMICRY.**

THE theory of mimicry suggested by H. W. Bates, in 1862, explained the superficial resemblance of a rare to a common species in the same locality by supposing that the latter possessed some special means of defence (such as unpleasant taste, smell, etc.),

*Abstract of a paper presented by E. B. Poulton before the Section of Zoology of the American Association for the Advancement of Science.

and that the former, without the special defence, was mistaken by enemies for the latter, and thus escaped a considerable amount of persecution. The relation may be compared to that existing between a successful well-known firm and another small unscrupulous one which lives upon its reputation. On the other hand, Bates thoroughly recognized the existance of resemblances between the specially defended forms themselves. These he could not explain by his theory of mimicry, and suggested that they were a result of the influence of locality. Many years later Fritz Müller satisfactorily explained this difficulty by suggesting that a common type of appearance simplified the education of enemies and thus was the means of saving life. The lives of many individuals must be sacrificed before enemies have learned to recognize and to avoid the colors and patterns which indicate some special means of defence, and the fewer such patterns in any locality the smaller the sacrifice. The relation may be compared to that between two successful firms which combine to use a common advertisement.

This latter theory, although received rather coldly at first, has gradually made way, and seems now likely to occupy a good deal of the ground formerly believed to be covered by the former theory. Thus, Dr. F. A. Dixey, of Oxford, has recently shown that South American *Heliconinæ* are affected by the color of certain *Pierinæ* which have hitherto been looked upon as true Batesian mimics of the former.

The Old World Nymphaline genus *Hypolimnas* has been regarded as one of the best examples of mimicry, but an unbiased examination leads to the opinion that it affords a case of Müllerian rather than Batesian resemblance.

In India the female of the common species *H. bolina* resembles *Euplœa Core*, while the male is a dark butterfly with a large white spot shot with blue on each of the four wings. Throughout the Malay Archipelago representative species occur with males like that of *H. bolina* and females resembling the local *Euplœas*. Occasionally, as in Ké Island and the Solomons, species of the genus occur in which the male as well as the female resembles a *Euplœa*. In Fiji the male is as in the Indian species, while the female is extremely variable, ranging from forms like the male through intermediate varieties to brown and straw-colored individuals. The *Euplœas* of Fiji are not sufficiently known, but it is very improbable that all the forms of the female *Hypolimnas* are mimetic. A still more instructive case is that of the *nerina* form of female found, with a male like that of *H. bolina*, in Australia, Celebes, New Guinea and other East Indian islands and in many of the Polynesian groups. This conspicuous and abundant butterfly has, in addition to the four white-and-blue spots of the male, a large reddish brown patch upon each forewing. This well-marked form resembles no other butterfly except the *Danais chianippe* of Celebes, and, as this latter appears to be very rare, it is far more probable that the resemblance has come from the other side, and that the *Danais* has approached the *Hypolimnas*.

In Africa the subgenus *Euralia* is represented by several species which resemble in both sexes species of the Ethiopian Danaine genus *Amauris*.

Finally, there is a well-known and widespread *Hypolimnas misippus*, which accompanies *Limnas chrysippus* throughout its range; while the female of the former resembles the latter very closely. In this case it is certain that we have to do with no struggling, hard-pressed form, for the *Hypolimnas* has recently established itself in some of the West India Islands and in Demerara —localities in which its model, *L. chrysippus*, is as yet unknown.

To sum up, the genus *Hypolimnas* is distinguished among Nymphaline genera for the extent to which its numerous and widespread species resemble the local distasteful forms of Euplœinæ or Danainæ.

Upon the older theory of Bates this would be explained by supposing that the genus is very hard-pressed in the struggle, and has thus been driven to mimicry almost everywhere. Upon the newer Müllerian theory it is supposed that the genus is distinguished among Nymphaline genera by some special defense, probably in the way of taste or smell or indigestibility, and that it has been to its advantage to adopt the advertisement of still better known and probably still more distasteful forms in its locality.

The abundance of the various species, the conspicuous *nerina* form of female, and the resemblance of a rare Danaid to it, the recent spread of *H. misippus* beyond the limits of its model, all support this latter interpretation.

NOTES ON ENGINEERING.

THE cost of power in New England cotton mills has been, of late, the subject of some discussion in technical and lay journals. The lowest cost yet reported, with one exception, is that given by Mr. Sheldon for the case of a mill which, paying $1.76 per ton for coal, obtained the horse-power for a total cost per annum, including all items on the treasurer's books, interest, depreciation, taxes, etc., of $11.64.

This figure was challenged and compared with the items generally given for other classes of engine which are usually two or three times as great and often much more. But the latest report comes from the Warren Steam Cotton Mill, where an engine of 1,950 horse-power, a cross-compound condensing machine, with cylinders 32 and 68 inches diameter and of five-feet stroke of piston, making 74 revolutions per minute, steam at 155 pounds at the boiler, supplies power at the cost of 1.35 pounds of coal per horse-power hour. The engine was designed by Edwin Reynolds, the boilers built by the Heine Company. The following are the figures certified to Dr. Thurston by the treasurer of the mill. The engine replaces a quadruple-expansion engine, destroyed by fire, after seven years of excellent service. The change illustrates the fact that the cost of the higher grade of machine may more than compensate its exceptional economy; a fact which has only in late years come to be recognized.

In the following table of the costs of the new engine the figures come from the treasurer's books. Coal costs $2.26 per ton, and in the account includes all costs of all steam used for all purposes, including banked fires, nights and Sundays, and that supplied the mill.

The following is a tabulated statement of the cost of power:

Fuel per horse-power per year of 3,070 hours	$ 4 70
Labor	1 88
Supplies and repairs	42
Total operating expenses	$ 7 00
Interest at 5 per cent	$ 2 05
Depreciation, at 5 per cent	2 05
Taxes	41
Insurance	04
Fixed charges	$ 4 55
Totals cost of power per year	$11 55

According to the Providence (R. I.) *Journal:* "This is lower than anything yet found. It is due to the large size of plant, which reduces the labor and supply account per horse-power, and to low cost of fuel and insurance and low cost of plant, on account of its size. The cost of plant includes a Green economizer, chimney, boiler-house, engine-house and foundations—all first class—and water-tube boilers, whose depreciation ought not to be over 2½ per cent. If steam used for other purposes than power were deducted, it would reduce the fuel 10 per

cent., or 47 cents per year, per horse-power, making the total $11.08. There is no way of separating this amount from the total in the regular accounts."

So far as known, this is the lowest cost of steam-power in any New England textile mill. The tons fuel per horse-power per year is 2.08—the lowest noted; others run about 2.20 tons per horse-power and upward.

R. H. T.

SCIENTIFIC NOTES AND NEWS.

Professor Michael Foster will deliver several lectures in Baltimore in October and will visit Boston later to deliver a course of lectures at the Lowell Institute.

Professor James E. Keeler, of the Allegheny Observatory, has accepted an invitation to make the dedicatory address at the opening of the Yerkes Observatory.

Dr. Fridjof Nansen is expected to arrive in New York on the steamer St. Paul, on October 23d. After visiting Washington as the guest of the National Geographic Society, he will give his first lecture in Carnegie Hall, New York, on October 28th. At the close of the lecture a medal will be presented to him by the American Geographical Society. The collections now at Stockholm will be brought to America and exhibited here.

Sir William Turner, President of the Anthropological Section, of the British Association for the Toronto meeting sailed from Montreal on the 22d. He will in future devote his time less to histological and more to anthropological researches.

We regret to notice the death of Dr. Holmgren, since 1864 professor of physiology in the University of Upsala, at the age of sixty-six years.

The following deaths are also announced: Dr. August Mojsisovics Edler v. Mojsvar, professor of zoology in the Polytecnic Institute at Graz; Mr. William Archer, F.R.S., librarian of the National Library of Ireland; Dr. T. Bogomoloff, professor of medical chemistry in the University of Kharkoff; Dr. John Braxton Hicks, F.R.S., one of the pioneers of British work on diseases of women, and a Fellow of the Royal Society since 1862.

The British Association, at the recent Toronto meeting, granted £1,350 for scientific research. We hope to give next week details of the appropriations.

The French Academy has accepted a legacy from M. Pierre Lassere amounting to over $100,000; the income from one-third of this sum is to be awarded by the Academy of Sciences for a scientific discovery.

A small fund, founded in memory of Surgeon-Major Arthur Barclay, is to be used for a bronze medal to be awarded every third year by the Asiatic Society of Bengal for the most meritorious piece of work done in original research in biology, with special reference to India.

A bronze monument, erected in honor of Marcello Malpighi, the eminent Italian anatomist and botanist of the seventeenth century, was unveiled at Crevacore, near Bologna, on September 8th.

The new museum of the Brooklyn Institute of Arts and Sciences will be dedicated on October 2d. Addresses will be made by President Eliot, of Harvard University, and by Mayor Wurster, of Brooklyn. There will be a reception in the evening in the Academy of Music.

It is reported that plans have already been made for the new building of the American Geographical Society, New York, although the site has not yet been decided upon. The present building in West 29th street, purchased in 1875, has long been outgrown by the Society, and it has assets amounting to nearly $400,000. The Society owes its present position and great growth to Judge Daly, who for thirty-three years has been its President.

The Greek Archæological Society has secured possession of a quarter of Athens lying immediately under the Acropolis. The inhabitants will remove to the suburbs, and excavations promising important discoveries will begin shortly.

A series of seven kites of the Hargrave type, sent up from the Blue Hill Observatory on Sep-

tember 19th, reached a height of 9,386 feet above the summit of the hill, this being the highest ascension thus far made. The kites carried an aluminium box with instruments for recording temperature, pressure and humidity, and the records are a further demonstration that kites may become a valuable addition to the methods of meteorology.

A MICROTOME for making sections of the entire human brain is being constructed by Messrs. Bausch and Lomb on the pattern of the 'automatic precision microtome,' recently described in our pages. The manufacturers expect that the new instrument will make large sections of greater thinness and accuracy than it has been possible to obtain hitherto.

THE *Atlantic Monthly*, 'devoted to literature, science, art and politics,' has completed its fortieth year with the current number and publishes an editorial retrospect eight pages in length. Its scientific work is thus described: "In 1862 scientific articles by Agassiz began to appear, and a long succession of his writings was brought to an end by a paper published in 1874, just after his death. Even if the *Atlantic* had done nothing else in the field of science this record would be worth making; but the great achievements of these later years have always formed an important part of its contents, and have been related by men like Rodolfo Lanciani, Percival Lowell, N. S. Shaler, G. F. Wright and T. J. J. See, who has a notable article in the present number." Compared with the men of letters mentioned by the *Atlantic Monthly* this list indicates that its devotion to literature has exceeded its devotion to science.

THE New York State Library Association, at its meeting in 1896, recommended the fifty books of 1895, regarded as best for a village library. The scientific books included are as follows: Edward Clodd, 'Story of primitive man;' Percival Lowell, 'Mars;' S. H. Scudder, 'Frail children of the air;' M. O. Wright, 'Birdcraft;' Philip Atkinson, 'Electricity for everybody.'

THE University of the State of New York has published the report of the Public Libraries Division for 1896, which gives a complete and interesting survey of the growth of libraries in the State. 806 libraries of 300 volumes or more have sent in reports. These libraries contain a total of 4,647,661 volumes, of which number 296,498 were added during the year. The libraries in the State having over 100,000 volumes are as follows:

New York, N. Y., Public Library, Astor, Lenox and Tilden foundations 367,808; New York, Mercantile Library, 253,783; Albany, New York State Library, 223,547; New York, Columbia University Library, 223,000; Ithaca, Cornell University Library, 186,683; Brooklyn, Brooklyn Library, 124,-299; New York, General Society Mechanics and Tradesmen Library, 106,440.

The libraries that added over 10,000 books during 1896 are as follows:

Columbia College Library, 20,580; New York Public Library, 15,594; New York State Library, 14,570; Cornell University Library, 13,578; New York Free Circulating Library, 11,201.

THE Minnesota Child Study Association, organized in 1895, has published a hand-book of 60 pages, which may be secured for 30 cents from the Secretary of the Association, Mr. E. A. Kirkpatrick, Winona, Minn. The pamphlet contains a number of suggestions and syllabi for the study of children, which will prove useful, more especially in view of the lack of a systematic treatise on the subject.

IN a letter, lately published, from Mr. Voorhes, Vice-President, to Mr. Charles H. Fahl, the engineer of the train, the former gives the figures for the runs of the train between Camden and Atlantic City last season, and gives deserved credit to the engineer. The facts are most remarkable and creditable, and the action of the Vice-President of the road is commendable in a remarkable degree. Were it an ocean steamer of which the performance was thus described the credit would have been given solely, in the usual case at least, to the commanding officer; the engineer would have been forgotten. Mr. Voorhes says: "The train record shows that for the fifty-two days the train ran, from July 2d to August 31st, the average time consumed on the run was forty-eight minutes, equivalent to a uniform rate of speed, from start to stop, of sixty-nine miles an

hour." * * * "This performance, I believe, has not been equaled in the history of railway service, either in this country or abroad. It is one of which the management is proud, and is accredited to the track, the equipment, and, especially, to the skill with which you performed the task entrusted to you." The distance was fifty-five and a-half miles, and the train consisted of five or six cars. It was always delayed by its connections at starting, and always came in ahead of schedule time; the total thus being brought four minutes under schedule time. The thanks of the railway officials are tendered Mr. Fahl.

THE Congrès Olympique recently held at Havre has passed resolutions summarized in the *British Medical Journal* as follows: Every three months parents are to be informed of the physical development of their children being educated in schools and colleges. That hygiene, physical training and athletic sports should be introduced in all schools, *lycées* and colleges. In all schools, colleges and *lycées* a service of hydrotherapy should be in working order. That a diploma for gymnastics be created, requiring a practical and oral examination.

THE Eleventh International Congress of Orientalists has held a successful meeting in Paris, many important archæological papers having been presented and plans having been made for further explorations in the East.

THE Council of the Society of Arts have appointed the following Committee to investigate the causes of the deterioration of paper: Major-General Sir Owen Tudor Burne, G.C.I.E., K.C.S.I., Chairman of the Council; Sir William Anderson, K.C.B., F.R.S.; Mr. Michael Carteighe; Mr. C. F. Cross; Sir John Evans, K.C.B., F.R.S.; Dr. Richard Garnett, C.B.; Dr. Hugo Müller, F.R.S.; Dr. J. W. Russell, F.R.S.; Mr. W. L. Thomas; Professor J. M. Thomson, F.R.S.; Mr. Henry R. Tedder; Dr. Quirin Wirtz; Sir Henry Trueman Wood, Secretary. *Nature* states that, in the course of a circular letter which has been sent to those who are interested in the preservation of paper, it is pointed out that many books of an important character are now printed upon paper of a very perishable nature, so that there is considerable risk of the deterioration and even destruction of such books within a limited space of time. This is believed to be especially true of books which are in constant use for purposes of reference, and are therefore liable to much handling.

ACCORDING to the New York *Tribune* the most interesting work now going on at the Weather Bureau is the preparation of an exhibit of this Bureau for the Paris exhibition in 1900. Professor Moore is taking a deep interest in the matter, and, as planned, it will be one of the largest and most complete expositions of this character ever made. A feature of the exhibit will be a daily weather chart of the United States. A code has been adopted by which the conditions of the weather in all parts of the United States will be transmitted by telegraph to Paris. From the material thus obtained maps will be constructed on the order of those now in general use. Professor Moore, with five or six of his subordinates, will represent the Weather Bureau at the exposition, and nothing is being left undone to make a showing worthy of the United States Bureau, which is acknowledged by scientific authorities to be the finest in the world.

LIEUTENANT PEARY, on arriving at Philadelphia, is reported to have said that in addition to securing the meteorite he laid the plans for next year's expedition, and when he leaves again, which will be about the end of next July, it will be to remain in the Arctic regions until he reach the Pole or lose his life in the attempt, even if it take five years to accomplish this object. Next summer he will take his vessel up to Sherard Osborne Fjord and make that place his base of supplies. On the last trip he made arrangements with the Arctic Highlanders, a tribe of Esquimaux consisting of 230 men, women and children, known as the most northerly tribe of human beings on the earth, to spend this coming winter in obtaining bear, seal and deer skins for clothing and in securing all the walrus meat they can for dog food. He has singled out eight young men of the tribe, with their wives, canoes, dogs, sledges and tents, to accompany him to Sherard Osborne

Fjord, which is about three hundred miles further north than their present abode. The party will consist of a surgeon, possibly another white man and Lieut. Peary; the rest will be Esquimaux. The latter know how to drive dogs; they can go hungry and know how to get food. The conditions under which he will make the coming expedition are of the most satisfactory character. The American Geographical Society has assured $150,000 to meet all expenses. Lieutenant Peary has five years' leave of absence. He will probably buy a new ship for next year, though he may possibly use the Hope again.

UNIVERSITY AND EDUCATIONAL NEWS.

INSTITUTIONS FOR HIGHER EDUCATION IN THE UNITED STATES.

The report of the Commissioner of Education for the year 1895–6 reports that the total number of universities and colleges for men and for both sexes reporting during the year was 484, of which number 345 admit women to undergraduate courses of study. There are 188 institutions which have not as yet any endowment; 54 have endowment funds less than $25,000, and only 4 institutions have endowments exceeding $5,000,000. In a large number of the institutions a comparatively small part of the work is collegiate. There are at present 278 institutions having less than 100 students in undergraduate collegiate courses. The number of instructors reported by the 484 institutions was 12,277, while the number of students of all classes, secondary and higher, was 159,372. Of the latter number 47,014 were in preparatory departments, 68,629 in collegiate departments, 4,673 in graduate departments and 25,438 in professional departments. The property reported was as follows: Volumes in libraries, 6,453,677; value of material equipment, $134,093,435; endowment funds, $109,562,433. The benefactions for the year, so far as reported, amounted to $8,342,728, and the income, excluding benefactions, was $17,918,174.

The 162 colleges for women had, in 1894–'95, 2,552 instructors and 24,663 students. The material equipment was valued at $15,568,508, and the endowment funds amounted to $5,308,558. The income was $3,456,983, and the benefactions received during the year amounted to $611,245.

The number of schools of technology, excluding technological departments of universities and colleges, was 48, having 1,118 instructors and 12,816 students. The total value of all property was reported at $24,105,242, of which amount $10,384,293 was reported as endowment funds. The income of these institutions was $3,526,018, of which amount $2,402,332 was appropriated by the General and State governments. The gifts and bequests received by the schools of technology amounted to but $96,133.

The increase in attendance at these universities and colleges is shown in the accompanying figure:

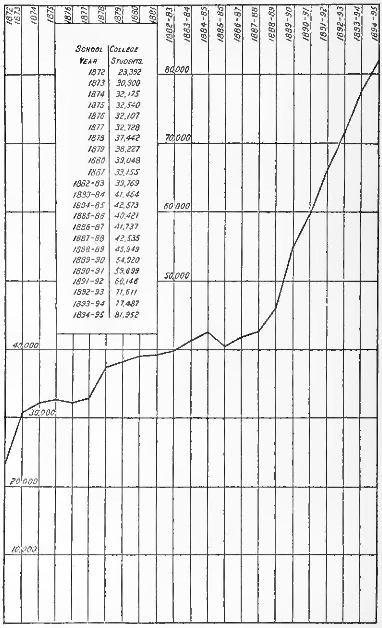

Fig. 1. The increase in attendance at American universities and colleges from 1872 to 1894-5.

GENERAL.

IT is reported that Harvard College and the Massachusetts Institute of Technology will each receive about $500,000 from the estate of the late Henry O. Pierce, under whose will they are, together with three other institutions, the residuary legatees. The amount to be divided has proved much larger than had been anticipated. The value of these bequests is much increased by the fact that they are unaccompanied by restrictions.

THE will of the late Eliza W. S. P. Field gives $80,000 to the University of Pennsylvania, and makes the University residuary legatee of her estate.

MRS. ESTHER B. STEELE, of Elmira, N. Y., has given $5,000 towards the cost of a physical laboratory for Syracuse University. The building, which will cost about $25,000, will be erected shortly.

FURMAN UNIVERSITY, at Greenville, S. C., has been given by Dr. and Mrs. F. A. Miles real estate valued at $20,000.

THE will of Theodore Lyman, whose death we were recently compelled to record, bequeathes $10,000 to Harvard University and a collection of valuable books to the Museum of Comparative Zoology.

EX-GOVERNOR FLOWER has given $5,000 to Cornell University for the purpose of a library for the Veterinary College.

THE will of the late Henry W. Sage, lately President of the Board of Trustees of Cornell University, to which institution he had given about $1,250,000, disposes of property worth $12,000,000, but makes no public bequests.

DR. ELISHA GREGORY, JR., formerly demonstrator of anatomy at the University of St. Louis, has returned, after a year's study in Germany, to enter upon his duties as instructor in histology and embryology at the Harvard Medical School.

PROFESSOR PETER T. AUSTEN has left the department chemistry at the Polytechnic Institute, Brooklyn, and is succeeded by Professor Fay.

MR. C. H. BENEDICT has been appointed instructor and Mr. J. M. Talmage assistant in chemistry in Cornell University.

AT a meeting of the regents of the University of the State of California the resignation of Professor Colton from the staff of the Lick Observatory was accepted.

THE following appointments have been recently made: Dr. Weiss, professor of mathematics in the Institute of Technology at Prague; Dr. Herzig, associate professor of chemistry in the University of Vienna; Dr. Zelinka, of Graz, professor of zoology in the University at Czernowitz; Dr. Zwaardemarker, professor of physsiology in the University of Utrecht; Dr. Julius Hann, director of the Vienna College of Meteorology, professor of meteorology at Graz, in Styria; Professor Joseph Pernter, professor of cosmical physics in Innsbruck University, appointed to the vacancy caused by Dr. Hann's retirement from the Vienna College; Dr. W. Ernest Thomson, professor of anatomy in Anderson College, Glasgow, and M. Brunhes, professor of physics in the faculty of science at Dijon.

THE Cambridge University Calendar shows that the undergraduates in residence at the University now number 2,928, of whom 664 are members of Trinity College and 264 of St. John's.

THE *Athenæum* says that a proposal is being considered to establish at Swansea, as a great manufacturing center, a branch University College in association with either Aberystwith or Cardiff, as the Newcastle College is associated with Durham. The suggestion is that scientific and technical courses might be taken at Swansea in preparation for the Welsh University degree.

DISCUSSION AND CORRESPONDENCE.

METEOROLOGY IN SOUTH AMERICA.

TO THE EDITOR OF SCIENCE: During the writer's present trip down the eastern coast of South America, he has gathered a few facts regarding meteorological work on this continent which may interest the readers of SCIENCE.

The only complete meteorological service in

South America is that of the Argentine Republic, with headquarters at Cordoba. The Argentine meteorological office, established by the late Dr. B. A. Gould, has, since the date of Dr. Gould's resignation as its director (1883), been under the direction of Mr. W. G. Davis. This service has at the present time nine first-order stations, fifty-eight second-order and one hundred and twenty-six third order. Of the first order stations, the most interesting in many respects, is that on the Isla de los Estados (Staten Island), off the southeastern extremity of South America, where the meteorological conditions present many unusual features. In addition, Mr. Davis will soon have in operation six new mountain stations, reaching from Patagonia along the Cordilleras into northern Argentina. These new stations will, in connection with the Harvard meteorological stations in Peru, form a splendid series along the western coast of South America.

As yet the Argentine meteorological service makes no attempt to publish a daily weather map or to issue forecasts, the director believing that his first duty is to establish and equip his stations, and to study the general climatological features of the region. *The Anales de la Oficina Meteorologica Argentina* already number nine large volumes, containing meteorological data as to the climate of Argentina. Vols. X. and XI. are now in press, and contain, among other data, the observations made on the Isla de los Estados, and a discussion of them. In addition to the ordinary work directly connected with the weather service, the director has made studies of the climatic conditions of different parts of the country as bearing on the raising of various crops, on the manufacture of cotton, etc., and of the relation between atmospheric conditions and disease in Buenos Ayres and Cordoba. The physiological effects of different weather types have also been studied. The forthcoming census of Argentina will contain chapters on the climatology of the country, illustrated by charts, also the work of the director. The observers of the Argentine meterological service now receive ten dollars (paper) a month for their services, and it is the policy of the director to do all he can to keep them interested in their work and to secure as accurate observations as possible from them. He accomplishes this by constant personal correspondence with the individual observers, and by sending them such meteorological books as they may wish to see and which he is able to loan them. At present, for instance, he is sending out eighty copies of the new cloud atlas to the observers. Such a policy is worthy of adoption by other weather services.

In 1882 the capital of the province of Buenos Ayres was removed from Buenos Ayres to the new city of La Plata, in Latitude 34° 55′ S., Longitude 57° 54′ W. Here an observatory was built for carrying on astronomical, magnetic and meteorological work, and a provincial weather service has been organized under the direction of V. Bœuf. The headquarters are at La Plata, and there are at present some sixty stations in all. Sixteen of these take the ordinary observations at 8 a. m. and 8 p. m., and report by telegraph to La Plata every morning, while the remaining (pluviometer) stations report wind direction, cloudiness and rainfall. The La Plata Observatory publishes a daily weather map, based on these data, and this is the only map of the kind at present issued in South America. This is no forecast, and the map relates solely to the province of Buenos Ayres, and not to the republic as a whole. The chief office has a poor instrumental equipment, there being, at the time of the writer's visit, no self-recording instruments in operation. Cloudiness is estimated in quarters of the sky covered, instead of in tenths, as is usually the case. Hourly observations are made at La Plata every hour from 6 a. m. to 8 p. m.

At Rio de Janeiro meteorological observations are regularly made at the National Observatory, situated on the most easterly hill of the city, overlooking the harbor. The instrumental equipment is good, and observations are made eight times in every twenty-four hours (1, 4, 7 and 10 a. m. and p. m.). The observatory is under the direction of L. Cruls, who also has charge of the geographical and geodetic work of the republic. The meteorological observations have been published in various volumes of the *Annales de l'Observatoire*. M. Cruls has lately been the chief of a commission appointed

to inquire into and report upon the availability of a new site for the national capital. According to the Federal Constitution the capital must be removed from Rio de Janeiro to a more healthy location in the interior province of La Goyaz, at a considerable altitude above sea level. The above-mentioned commission has published an elaborate report, finely illustrated with photographs and charts, in which the geology, hydrography, climatology, etc., of the new site receive consideration. The work is a very interesting one.

Owing to the unfavorable atmospheric conditions at Rio, where the cloudiness is very considerable, there has for some years been a plan to remove the Observatory to a new location near Petropolis, in the Organ mountains, at an altitude of over 2,700 feet. Petropolis is a place much sought by the wealthier classes of Rio during the summer months, when yellow fever is most prevalent in the capital. It is high enough to be above the yellow fever zone, and its cool evenings and nights are much more agreeable than the hot nights of Rio. Furthermore, it is above the fogs which commonly hang over Rio harbor at night, and is therefore a much more favorable location for an astronomical observatory. The necessary funds for the removal are, however, lacking, and there is at present no prospect that the location of the Observatory will be changed.

There is a very common belief that the *climate* of Rio is unhealthy. This is by no means the case. The climate itself is a fine one in many ways, the unhealthy character of the city being due simply to the lack of attention to the simplest sanitary measures. Rio harbor itself, beautiful as it is, is the most deadly feature about the whole place. The waters are so foul, as a result of the improper disposal of the city's sewerage, that they are a veritable storehouse of disease. When the city adopts proper sanitary regulations and builds sewers to empty its drainage into the open ocean, instead of into the harbor, then Rio will become as healthy as a city with its beautiful situation deserves to be.

This letter is mailed in the Falkland Islands. Although the meteorology of these islands is most interesting, regular observations are no longer made here. Those made here in the past have been discussed by Marriott (Quart. Jour. Roy. Met. Soc., London, 1880), and by von Dankelmann (Ann. d. Hydrog, Berlin, 1885). Mr. Davis, of the Argentine meteorological office, has sent two sets of instruments to the islands, but has not yet succeeded in securing regular observers. The climate of the islands is particularly interesting by reason of their far southerly position in the stormy prevailing westerlies of the southern hemisphere. Sunshine is so rare here in winter that, as an old resident of Port Stanley said to the writer to-day, "When we see the sun for an hour or two everyone says 'what fine weather we are having.'"

R. DEC. WARD.

PORT STANLEY, FALKLAND ISLANDS, July 29, 1897.

SCIENTIFIC LITERATURE.

Memoirs of the American Folk-Lore Society. Vol. V., 1897. Navaho Legends, Collected and Translated by WASHINGTON MATTHEWS, M.D., LL.D. With Introduction, Notes, Illustrations, Texts, Interlinear Translations, and Melodies. Boston and New York, Houghton, Mifflin and Company. Pp. 299.

A study of aboriginal life from the pen of Dr. Washington Matthews is always welcome, and this volume of Navaho Legends is no exception to the pleasant rule. Out of the abundant material collected by the author he has selected three legends for this publication: two incomplete rite-myths and the Navaho Origin Legend. The latter 'divides itself into four very distinct parts,' I. The Story of the Emergence; II. Early events in the Fifth World; III. The War Gods; and IV. The Growth of the Navaho Nation. The term rite-myth is defined as 'a myth which accounts for the work of a ceremony, for its origin, for its introduction among the Navahoes, or for all these things.'

The Navahoes, we are told, "celebrate long and costly ceremonies, many of which are of nine days' duration. Each ceremony has connected with it one or more myths, or legends which may not be altogether mythical." These rite-myths possess a degree of traditional value, and the last chapter of the Origin legend, our author says, 'is in part traditional or historical, and is even approximately correct in many of

its dates.' This group of legends, therefore, belongs to a class, the knowledge of which is indispensable to a reconstruction of the past life of a tribe, or to the understanding of existing conditions of the people, or to the tracing of the contact and interrelations of tribes prior to the historic period of this continent.

The introduction, and more particularly the volumious notes, in the preparation of which the author had in mind their 'interest to the ethnographer,' are replete with information. They explain, more or less in detail, customs mentioned incidentally in the legends, and cite the evidence by which localities referred to in the text have been identified. They also contain extracts from varients of the legends, and note other rites and myths in which figure the divinities of the narrative, and give numerous linguistic and other explanations of names, rites, customs, etc., which put the reader in possession of knowledge invaluable for the study of these Indians. The breadth of view of the subject treated is enlarged by abundant cross references, both to matter within the volume and to other writings of the author upon the Navahoes, a complete list of which is included in the Bibliographic Notes compiled by Mr. F. W. Hodge, forming a part of the book.

In presenting these legends to the public the author has "not confined himself to a close literal translation. Such translation would often be difficult to understand, and, more often still, be uninteresting reading. * * * The tales were told in fluent Navaho, easy of comprehension, and of such literary perfection as to hold the hearer's attention. They should be translated into English of a similar character, even if words have to be added to make the sense clear. * * * If he has erred in rendering the spirit of the savage authors, it has been by diminishing rather than by exaggerating. * * * In order that the reader may judge how closely the liberal translation here offered follows the original, the Navaho text of the opening passages—ten paragraphs—of the Origin legend, with interlinear translations, are given in the notes."

Fifteen pages or more of these interlinear translations afford an opportunity to observe the construction of the language and its use in narrative, ritual and song.

The examples of Navaho songs are interesting, not only in relation to the legends and the use of the language with poetic intent, but because they show that the same device obtains among the Navahoes which is common with the Indians of the Siouan linguistic group, a device to produce the effect of rhyme by means of certain 'meaningless vocables' at the close of each sentence. In his introduction, Dr. Matthews calls attention to the use of archaic words in the songs, to which 'the priests assign traditional meanings;' and also to the 'numerous meaningless vocables in all songs,' which 'must be recited with a care at least equal to that bestowed on the rest of the composition.' The same precision is required in the repetition of the vocables in the songs of the Siouan group. The writer having discovered that the emotional prompting of the song decides the choice of these vocables, it is especially interesting to note that, making allowance for the wide difference of language, the vocables given in the Navaho songs seem to follow the same rule that appears to govern their use among the northern tribes.

The short essay by Professor John Comfort Fillmore, upon the music—included in the notes—is of peculiar interest. His extended experience with Indian songs, added to his scholarly attainments in music, makes whatever he has to say upon this subject worthy the careful consideration of those interested in this phase of ethnological research. To quote from Professor Fillmore, Note 272, speaking of the songs transcribed from the phonographic records taken by Dr. Matthews, "they have very great scientific interest and value, inasmuch as they throw much light on the problem of the form spontaneously assumed by natural folk songs. Primitive man, expressing his emotions—especially strongly excited feeling—in song, without any rules or theories, must, of course, move spontaneously along the line of least resistance. This is the law under which folk-melodies must necessarily be shaped. The farther back we can get toward absolutely primitive expression of emotion in song, the more valuable is our material for scientific

purposes; because we can be certain that it is both spontaneous and original, unaffected by contact with civilized music and by any and all theories. In such music we may study the operation of natural psychical laws correlated with physical laws, working freely and coming to spontaneous expression through the vocal apparatus.

"These Navaho songs are especially valuable because they carry us well back toward the beginnings of music making. One only needs to hear them sung, or listen to them in the admirable phonographic records of Dr. Matthews, to be convinced of this from the very quality of tone in which they are sung. In all of them the sounds resemble howling more than singing, yet they are unmistakably musical in two very important particulars: (1) In their strongly marked rhythm. (2) In the unquestionably harmonic relations of the successive tones."

The limits of this article forbid following Professor Fillmore in his treatment of these two particular points, Rhythm and Harmonic melody, or to recount the evidence leading to his conclusion 'that the harmonic sense is the shaping, formative principle in folk melody.'

Of the many interesting points brought forward in this volume, only one or two can be indicated, and these are selected not so much to give the scope of the volume as to illustrate its wealth of suggestion.

In accounting for the limited number of arts practiced by the Navahoes, the author says: "In developing their blanket making to the highest point of Indian art, the women of this tribe have neglected other labors. The much ruder but allied Apaches, who know nothing of weaving woolen fabrics, make more baskets than the Navahoes, and make them in much greater variety of form, color and quality. The Navahoes buy most of their baskets and wicker water jars from other tribes. They would possibly lose the art of basketry altogether if they did not require certain kinds to be used in the rites, and only women of the tribe understand the special requirements of the rites." It would seem that special proficiency in the manufacture of some one article, while it may limit the development along other lines, leads to trade and the peaceful intercourse between different peoples.

In introducing the subject of poetry and music the author calls attention to the fact that for many years the most trusted account of the Navaho Indians was to be found in a letter published in the Smithsonian Report for 1855. The writer had lived three years in the heart of the Navaho country, and was aided in preparing this letter by an officer in the United States Army who had long commanded a post in the vicinity, both being men of unusual ability. From this letter the following statement is taken: "Of their religion little or nothing is known, as, indeed, all inquiries tend to show that they have none. 'The lack of tradition is a source of surprise. They have no knowledge of their origin or of the history of the tribe.' 'They have frequent gatherings for dancings.' 'Their singing is but a succession of grunts, and is anything but agreeable.' In spite of the evidence of these gentlemen, fifteen years ago when the author first found himself among the Navahoes he was not influenced in the least by the authority of this letter. He had not been many weeks with these Indians when he discovered that the dances referred to were religious ceremonials, vying 'in allegory, symbolism, and intricacy of ritual with the ceremonies of any people, ancient or modern.' The 'succession of grunts' reveal 'that besides improvised songs, in which the Navahoes are adepts, they have knowledge of thousands of significant songs—poems, as they might be called—which have been composed with care and handed down, for centuries perhaps, from teacher to pupil, from father to son, as a precious heritage, through the wide Navaho nation.' "

The author's rich gleaning in a field pronounced barren can be repeated elsewhere in the land, but, to achieve results like his, similar equipment is necessary. It is not enough, as the incident just quoted shows, 'to live in the vicinity' of a people; to report accurately upon them, one must have come so near to them and in such manner as to draw from willing lips their tribal lore.

It would be unjust to Dr. Matthews's work, and to the lesson it contains for us, not to call attention to the characteristic which is an important factor in making him a trustworthy authority in any field where he has studied,

his hearty recognition of the claims of a common humanity. This recognition makes him appreciate the seriousness of interpreting the men of one race to men of another race, and begets a fairness of presentation that lifts his work to a high standard of truthfulness. His manly conscientiousness is evident throughout the book in the choice of words, in the turn of a sentence, in the "testimony in favor of the Shamans, and the incidents related of Tall Chanter, Torlino and others; it is also noticeable in the illustrations of the book, particularly in the portraits, which, while characteristic, are without the brutal exaggerations of feature so painfully common in Indian pictures. While this may be regarded as the personal equation of the author, it nevertheless indicates certain qualities, the presence or absence of which in a field investigator helps or mars his work."

The contributions to ethnology offered in this volume are particularly timely, for the questions, "How have the tribes of North America been built up?" and "what have been the directive influences in determining their arts, cults and organization?" are of increasing importance, as the study of our native peoples passes beyond the initial stage. The student is under great obligations to the author for the perspicuous presentation of his material, due to his grasp of the subject, power of classification and concise statement, and his ability to rigorously exclude extraneous matter.

The excellent workmanship of the book—the type and illustrations, three being in colors—is worthy of the publishers, and reflects credit upon the Folk-Lore Society.

ALICE C. FLETCHER.

BOTANY OF THE AZORES.*

SINCE the publication of Hewett C. Watson's chapters on botany in Godman's Natural History of the Azores, published nearly thirty years ago, no important contributions have been made to the botany of this group of oceanic islands. The present paper, based on two summers spent in the islands, is a catalogue of all of the plants, cryptogamic as well as phanerogamic, heretofore recorded as Azorean, with a reasonable attempt at the exclusion of synonyms, especially in the higher groups. While in the phanerogams comparatively few species have been added to those previously recorded, the distribution by islands is indicated much more fully than ever before, and the list of Thallophytes very considerably increased. It is stated that, although the list of flowering plants and ferns is believed to be nearly complete, and perhaps relatively few additions to the lichens will be made, the fungi are still practically unstudied, and the algal flora, especially that of the wet sphagnum with which the highlands are usually covered, is likely to be very greatly increased by careful study. In the catalogue a reference is given, under each species, to places in which it has previously been mentioned as Azorean, and an adequate description and plate are cited. Where the latter has not been practicable, the species has been figured. In connection with this paper should also be noted Cardot's recent paper on the mosses of the Azores and of Madeira, previously mentioned in these columns.

* Botanical Observations on the Azores. By William Trelease. From the Eighth Annual Report of the Missouri Botanical Garden, St. Louis, Mo. Issued September 9, 1897. 8vo, pp. 144, frontispiece and 55 plates.

NEW BOOKS.

The Dawn of Astronomy. J. NORMAN LOCKYER. New York and London, The Macmillan Company. 1897. Pp. xvi. + 432. $3.00.

The History of Mankind. FRIEDRICH RATZEL; translated by A. J. BUTLER. London and New York, The Macmillan Company. 1897. Vol. II. Pp. xiv. + 562. $4.00.

Traite elémentaire de mécanique chimique. P. DUHEN. Paris, A. Hermann. 1898. Vol. II. Pp. 378.

Wild Neighbors. ERNEST INGERSOLL. New York and London, The Macmillan Company. 1897. Pp. xii. + 301. $1.50.

Deductive Physics. FREDERICK J. ROGERS. Ithaca, N. Y., Andrus & Church. 1897. Pp. vi. + 260.

Missouri Botanical Garden. EIGHTH ANNUAL REPORT. St. Louis, The Trustees. 1897. Pp. 236.

SCIENCE

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FRIDAY, OCTOBER 8, 1897.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

A STATEMENT CONCERNING THE MARINE BIOLOGICAL LABORATORY AT WOOD'S HOLL, MASS.

THE undersigned wish to state to the public, and especially to those who have contributed to the support of the Marine Biological Laboratory, the circumstances which have resulted in their separation from the management of the institution of which they were recently trustees.

1. The Laboratory was founded by the Woman's Education Association, in cooperation with the Boston Society of Natural History at Annisquam in 1881, and in 1888 it was completely reorganized and changed into a corporation under the laws of Massasetts. Its affairs have been managed by a board of trustees, three of whom were members of the Woman's Education Association. All the members of the original board resided in or near Boston. A few years later the board was enlarged to take in representatives of universities in various States. The original board decided upon the location, scope and organization of the laboratory, bought the land at Wood's Holl, designed and erected the first building, selected and purchased the original equipment, and appointed Dr. Whitman director to administer the laboratory. The funds for the establishment of the institution came almost exclusively from Boston. During the following years additional land was bought, and five important additions to the buildings were made, for all of which the funds were secured through the exertions of the Boston trustees, with, however, a few lesser contributions from elsewhere. In 1896 another building was erected at a cost of $3,500, and of this

amount by far the larger part was raised outside of Boston and its connections. The total amount of money contributions is $41,029, of which about nine-tenths was secured through the Boston members of the board of trustees. To the list of these services to the laboratory must be added the establishment and maintenance of the large dining club, without which the laboratory could not have grown to its present size.

In consideration, then, of these facts, that the plan of providing both for instruction and for investigation, and the continued life of the laboratory, have hitherto depended primarily upon the efforts of the Boston trustees, may it not be claimed that they might reasonably have expected justice and consideration from those who alone had any direct advantage from their efforts.

2. Dr. Whitman was appointed Director and has ably carried out the original plans of the trustees, and though the general plan and scope of the Laboratory have remained unchanged from the start, Dr. Whitman has suggested and carried through valuable modifications and he has devoted his summers and other time to the Laboratory for nine years, and has served through the whole period without remuneration. Under these circumstances the trustees have always striven to meet Dr. Whitman's wishes in every practical way, and have repeatedly laid aside their own preferences and convictions in order to give the Director the fullest expression of their recognition of his services. There gradually arose, however, a serious divergence of views upon important points between Dr. Whitman, upon the one hand, and the trustees, as recorded by the votes and discussions of the board, on the other.

The first point related to the general policy of the Laboratory. A large majority of all the trustees who have ever attended a meeting were convinced that the wisest course was to plan at once a permanent building, with first-class equipment, and to endeavor to secure a permanent endowment. Dr. Whitman wished first to erect more temporary buildings, although the debt of the Laboratory was thereby increased. Out of deference to Dr. Whitman the Board yielded more than once, but last winter they showed a positive determination not to sanction the continuation of the policy.

The second point concerned the financial management. The trustees held that it was their duty to exercise an effective control of the finances, in accordance with their legal obligation under the act of incorporation, and, therefore, that they must regulate the general appropriations, such as those for salaries, for running expenses, etc. Dr. Whitman, on the contrary, apparently considered that the expenditures were to be regulated solely by him, and acted accordingly. He exceeded his appropriations for running expenses and spent money necessary for certain uses for an unauthorized purpose. The trustees adopted the most generous and lenient view possible of these occurrences, for they attributed them to Dr. Whitman's ignorance of the ordinary rules of financial administration, until the violations became so extreme that it was unavoidable to take prompt and efficient steps to protect the Laboratory.

The following instances illustrate the character of Dr. Whitman's financial standards. In his report for 1895, p. 28, he presents figures to show that each time the trustees acceded to his wish for a new building the earnings of the Laboratory increased faster than the expenses. But Dr. Whitman's statement of the expenses for five of the eight years was extremely incorrect,* as shown in the following table:

* It is to be regretted that the errors were not observed in time to withdraw them from publication.

Year.	Dr. Whitman's Figures.	Actual Figures.*
1888	$1320.	$2205.
1889	1554.	2377.
1890	2430.	3041.
1891	3498.	3346.
1892	4132.	4049.
1893	4264.	4110.
1894	4882.	6940.
1895	8010.	8474.

He failed also to note that with each new building, since 1891, the confidence in the Laboratory diminished and thereafter the gifts to the institution decreased.

Year.	New Building.	Gifts.
1888	(first)	$9926
1889	——	5400
1890	one	2984
1891	——	5875
1892	one	5113
1893	one	3613
1894	one	2977
1895	——	2368
1896	one	1122
1897	——	1651†

As an illustration of Dr. Whitman's views as to the finances of the Laboratory, he maintained that the last new building paid for itself because the rooms were occupied, but was unable to recognize that he had used the privilege of inviting guests to the Laboratory so liberally that if these workers, who paid nothing, had been dropped, the extra rooms provided in the new building would have been unnecessary. The charge for an investigator's room is $100. The number of non-paying guests invited by Dr. Whitman was fourteen in 1896 and eleven in 1897.

Again, last winter the Laboratory was in debt, a debt which the trustees were obliged to meet. The Assistant Director held certain sums which he had collected from sales of supplies. The Treasurer called in these sums, but was met by a refusal because the Assistant Director had been told by Dr. Whitman to retain the money, subject to his order.

Other illustrations of the embarrassments caused by Dr. Whitman in the financial management of the Laboratory might be enumerated.

The lack of financial ability, demonstrated by the Director, rendered it in the judgment of the Trustees, imperative to protect the interests of the Laboratory. The Trustees therefore appointed a trained business man as Bursar, who received orders to pay all bills approved by Dr. Whitman, up to the limit of the appropriations. The Bursar proved very efficient and satisfactory, and furnished the trustees with clear and definite summaries of the receipts and expenditures during the summer.

3. The trustees as a body were desirous of making the Laboratory a truly national institution, while Dr. Whitman apparently wished to convert it into an organization under his own exclusive control. The trustees decided to insist upon their authority as the fulfilment of a trust confided to them by the subscribers to the funds of the Laboratory.

At the close of the session of 1896 the trustees were confronted by a deficit of about $1,500,* according to the written official statement of the Treasurer. This deficit was due to two causes: *first*, Dr. Whitman had greatly exceeded the income at his disposal; *second*, he used nearly $400 necessary for covering the running expenses, and spent it for an unauthorized purpose, disregarding a vote of the trustees.

He justified this act by stating, afterwards, that Mr. Nunn had promised this sum for that use. To offset this deficiency the trustees had only certain expected fees

* Compiled from the Treasurer's Reports. As certain items, such as postage, printing, etc., which represent regular annual expenses are not included, several of these amounts are less than they should be.

† Includes Mr. Nunn's payment of $398.

*The exact amount could not be given, as certain bills had not been sent in.

for the past season, but these belated fees, amounting last year to several hundred dollars, it has been the custom to reserve to cover the expenses of opening the Laboratory the following season. Under these conditions it was impossible to plan to open the Laboratory until funds were secured to cover the deficit, and Dr. Whitman was so informed. The Laboratory had, in addition, a debt of about $5,500. After several months the $398.59 used by Dr. Whitman was restored to the treasury by a payment made for that purpose by Mr. Nunn. The trustees applied all the fees they could collect to cover the deficit and finally raised in Boston $1,144, and thereupon immediately made public announcement of the opening of the Laboratory.

Dr. Whitman, who was the cause of these difficulties, and therefore of the delay in issuing the announcement for 1897, blamed the trustees not only for their conservatism, but also for that delay and for the appointment of a Bursar, which his deficiencies had rendered indispensable.

A written offer was received in April, 1897, from Mr. L. L. Nunn, of Telluride, Colorado, a brother-in-law of the Director and one of the trustees of the Laboratory since January, 1896. This offer substantially was as follows:

Mr. Nunn offered to pay the deficit in the running expenses at Wood's Holl for the season of 1897, after devoting towards the payment of such expenses all proceeds obtained from the operations at Wood's Holl. These running expenses did not include insurance, interest on the debt, or the expenses of the Treasurer's office. The offer was made upon the condition that Dr. Whitman directed the Laboratory in accordance with his best judgment and that Mr. Allen, 'or some other person acceptable to me' (Mr. Nunn's words), be employed as Assistant Treasurer at Wood's Holl. Mr. Nunn made himself responsible only for expenses incurred with consent of said Assistant Treasurer or himself.

It is to be noted that Mr. Nunn offered an uncertain amount and made no promise of subsequent assistance, but did state expressly to the trustees, at a meeting, that no large gift could be expected from him. As the acceptance of this offer was conditional on the discharge of the Bursar already engaged by the trustees, and as the trustees did not consider it wise to relinquish all responsibility, even for a limited time, to one of their number, Mr. Nunn's proposition was declined by a recorded vote of nine to one, and the decision was communicated to him by the Treasurer in the following terms:

April 15th, 1897.

L. L. NUNN, Esq.,

Dear Sir:

I have your letter of April 9th from Provo, Utah, enclosing draft of your offer to the Trustees of the Marine Biological Laboratory.

The Trustees, after giving your generous offer careful consideration since your visit to Boston, and after a meeting at which the subject was fully discussed, were with one exception of the opinion that it would not be compatible with their duties as Trustees of the Laboratory, to resign into the hands of Dr. Whitman the entire direction of its policy, even though guaranteed by you against any financial loss during the coming season.

Your first letter and draft were never received by me; I presume they miscarried in the mail, and your second letter did not arrive until after the meeting, but I do not find anything in it which materially differed from the proposition as originally made to the Trustees by word of mouth. I shall transmit your letter and offer to the Secretary, in order that they may be submitted to the Trustees at their next meeting, but I think we may regard the matter as definitely settled without awaiting further action.

Personally, I believe that the decision of the Trustees was a necessary one; at the same time, I confess to great reluctance in foregoing on behalf of the Laboratory your generous assistance, and we must certainly all be very grateful to you for the interest you have taken in our project.

Yours truly,

LAURENCE MINOT.

4. The customary summer meeting of the

board of trustees was held at Wood's Holl on August 6, 1897. At this meeting only a small attendance is expected, as it is known that many members are usually absent on expeditions or vacations, and, accordingly, until this year only routine business had been transacted at this meeting. Before this meeting began, Dr. Whitman stated, deliberately, to the Acting President in response to a question, that there was no important new business to be brought forward. After the hour of the meeting the four members of the board who had come from Boston to attend were kept waiting half an hour for the arrival of the other members who were then at Wood's Holl, although it was known that most of the Boston trustees must return by the last train in two hours. On the motion of Dr. E. G. Gardiner some 150 new members of the corporation were elected, most of them students at the Laboratory. Without this election it is doubtful if the subsequent plans could have been carried through. After all the business known to the President and Secretary had been transacted, Dr. Whitman introduced an extended discussion on some matters of the past (about which no action was possible). Almost immediately thereafter it became necessary for three members to leave to take the last train to Boston, and a protest against continuing the meeting was made but was overridden. The meeting was continued by Dr. Whitman, Dr. E. G. Gardiner, Professor J. P. McMurrich, Professor S. F. Clarke and the Secretary, who remained. The proposition to hold the annual meeting at Wood's Holl, a piece of important new business, for which there had previously been ample opportunity was then brought forward, and the following votes were passed, the Secretary voting in the negative in each case. The Secretary also made strong protests against passing so revolutionary measures after the Acting President and two trustees had left the meeting.

Voted on the motion of Dr. E. G. Gardiner: That the clerk be directed to call a special meeting of the corporation to consider the advisability of changing the by-laws, the meeting to be held at the Parker House, Boston, on August 16th.

Voted: That the temporary chairman (Professor McMurrich) appoint a committee of three to formulate the changes in the by-laws.

The committee was constituted with Dr. Gardiner, chairman; Dr. Whitman and Professor Clarke.

The purpose of the proposed changes was to have the annual meetings of the corporation held at Wood's Holl, to change the board of trustees from a body practically self-perpetuating to an elective body, and to place the control of the Laboratory in new hands.

We consider the action taken entirely unjustifiable, owing to the methods employed. There are also special reasons which made it unsuitable for Dr. Whitman and for Dr. Gardiner and Professor McMurrich to pursue the course taken.

In his Report for 1895, p. 47, Dr. Whitman says: "It still remains possible for a minority of four to hold meetings at convenience in Boston and regulate the affairs of the Laboratory, and that, too, in the absence of every one familiar with the needs. It makes no difference whether this has or has not been done; the possibility of its being done is what jeopardizes vital interests of the Laboratory."

We call attention to the fact that Dr. Whitman, aided by Messrs. Gardiner, McMurrich and Clarke, is the first and only person who has profited by the possibility he so emphatically condemned, and that, by utilizing it, he and his three supporters succeeded in setting aside the expressed wishes of the board of trustees, and in changing

the national character of the Laboratory.

In August 1895, the trustees appointed a committee 'to take into consideration a reorganization of the governing body.' In 1896 Dr. Gardiner was made chairman of this committee, of which Professor McMurrich was also a member. A resolve proposing certain changes in the mode of government of the Laboratory, introduced by one of the trustees, was referred to the committee.

We regret that the committee, in spite of many repeated requests to its chairman, made no report, and that Dr. Gardiner and Professor McMurrich, instead of acting in consultation with their fellow trustees, adopted a plan to reorganize the government of the Laboratory by other means.

5. The special meeting was duly held at the Parker House, Boston, on August 16th. A large attendance from Wood's Holl was secured, it is said, by hiring a special car and offering to pay the fares of the members of the Corporation, many of whom had been elected only a few days before. It was proposed by some of the Boston trustees to ask for a hearing before this meeting, but the gathering seemed to them so evidently packed that they considered any attempt to obtain a hearing useless. The proposed changes in the by-laws were carried through. The most important one of these is that which fixes the annual meeting for the summer at Wood's Holl. This change seems well calculated to enable the Director to maintain practically control over the Corporation. Other changes made are likely also to favor this result.

The newly appointed annual meeting of the Corporation was held at Wood's Holl on August 24th. A new board of trustees was elected and five of the Boston trustees were dropped. The Boston trustees could make no defense, because they had never heard any accusations and had no information until the meeting of their projected exclusion. Moreover, nearly all the undersigned were necessarily absent from that meeting.

Although without the labors of the five trustees who were dropped from the board the Laboratory might never have existed, and although Dr. Whitman was under many obligations to them, they were ejected from the board by means which can only be considered underhand and dishonorable. We believe that such a policy must injure the Laboratory seriously and we are unable to give it support or approval.

The main points of this statement are as follows:

1. The recognition of the scientific ability of the Director, his devotion and services to the Laboratory.

2. The utter lack of sound financial standards shown by the Director.

3. The dishonorableness of the methods employed to reorganize the government of the Laboratory.

4. The ignorance of the facts on the part of the members of the Corporation present at the meetings of August 16th and 24th, which helped to make this reorganization possible.

Samuel H. Scudder,
President, 1891–96;
William G. Farlow,
Acting President, 1896–97;
Anna P. Williams,
Secretary, 1888–97;
Laurence Minot,
Treasurer, 1894–97;
Charles S. Minot,
Trustee, 1888–97;
Georgiana W. Smith,
Trustee, 1891–97;
Sidney I. Smith,
Trustee, 1891–97.

THE JESUP EXPEDITION TO THE NORTH PACIFIC COAST.

IT will be remembered that in the spring of this year Mr. Morris K. Jesup, President of the American Museum of Natural History, provided the means for a thorough ethnological investigation of the northern portions of the Pacific coasts of Asia and North America.

It was decided to begin field work on the American coast, and in May a party consisting of Dr. Franz Boas, Dr. Livingston Farrand and Mr. Harlan I. Smith left New York in order to carry on anthropological investigations in British Columbia. In previous years the Committee of the British Association for the Advancement of Science appointed for studying the tribes of northwestern Canada had carried on investigations in British Columbia. This committee was about to conclude its field work. Since the territory in which the operations of the Jesup Expedition are to be conducted embraces the field of work of the committee, it seemed desirable to have the operations of both parties conducted on a common plan. The committee was desirous of completing its anthropometric survey of British Columbia and to obtain information on the Tinneh tribes of the interior of that Province. This work was entrusted to the party of the Jesup Expedition and has been done by Dr. Farrand and Dr. Boas.

During the past season the work of the Jesup Expedition was directed mainly to an exploration of the prehistoric remains of British Columbia, to a study of the Bella Coola Indians and of the northern Kwakiutl Indians. A special study of the art of the Indians of the North Pacific coast was included in the plan of work. In all these directions good progress has been made. The work was divided in the following way. Mr. Smith was charged with the archæological investigations; Dr. Boas and Dr. Farrand collected anthropometrical data, and Dr. Farrand undertook the study of the Chilcotin for the British Association for the Advancement of Science, and later on carried on inquiries on the sociology of the northern Kwakiutl. Dr. Boas investigated the Bella Coola Indians and later on studied the art of the northern tribes. He concluded his work with a study of the language of the northern Kwakiutl. In British Columbia Mr. James Teit and Mr. George Hunt joined the party, the former to assist in work on the Thompson River Indians, the latter to assist in work among the Kwakiutl tribes. Mr. Teit has promised to furnish for the expedition a description of the Thompson River Indians. Mr. Hunt's services were of the greatest value on account of his intimate knowledge of the Kwakiutl language and of the customs of the people.

The result of this summer's work may be summarized as follows: Mr. Smith investigated archæological remains at four points: at Kamloops, Spence's Bridge, at the famous burial ground at Lytton and at Port Hammond.

The remains found at Kamloops belong to a number of periods preceding contact with the whites. In all the sites objects made of shell, copper, bone and stone were found. The general shape of these objects suggest that the people using them were the immediate ancestors of the tribes inhabiting these regions at the present day. Most of the material was found buried in shifting sand, owing to which fact the original order has been much disturbed.

The remains found at Lytton were of a character similar to those found at Kamloops. While a thorough investigation of the finds may show that there existed differences in the cultures of these regions, the general characteristics of the material are much alike. In both places the

finds were made in ancient burials or in caches.

At Port Hammond Mr. Smith investigated a number of shell heaps. These have a thickness of $4\frac{1}{2}$ feet or less, and the remains found in the heaps were ascertained to be not intrusive. A number of skeletons and well-preserved artefacts were found. There is no difference in the character of the objects found in the lowest layers and in the higher layers. Judging by the size of trees growing on the shell heaps, these sites must have been deserted for a considerable length of time, but there is no evidence pointing to a very great antiquity of the remains. Further conclusions cannot be drawn until the material obtained in these localities has been subjected to a thorough investigation.

Dr. Boas' investigations on the Bella Coola gave some results of considerable interest. Previous inquiries had shown that the Bella Coola possess a highly developed mythology. Further studies have shown that they are the only tribe on the North Pacific coast that have systematized their mythology. While among them we find most of the elements of the mythologies of the neighboring tribes, this material has been so elaborated that instead of a multitude of spirits we find a number of deities, each with its proper functions. The Bella Coola believe that there are five worlds, an upper heaven over which rules the supreme goddess Qamaits. The lower heaven is the home of a number of deities, the most powerful of whom is the sun, called by the Bella Coola 'Our Father' and 'The Sacred One.' The deities reside in a house located in the zenith. It is called 'House of Myths.' The thoughts of these deities are put into action by four brothers, who live in a separate room in the rear of the house. Here also reside ten brothers, to whose care the winter ceremonial is entrusted. The sun walks from east to west every day. In the east in heaven sits the 'Bear of Heaven,' watching the 'Place of Dawn.' On the west is the pillar, which prevents the sun from passing into the lower world. Twenty-four watchmen are appointed to look after the sky and to keep it in good order. Three others fly around the sun watching his course. At winter solstice and summer solstice are stationed two watchmen, whose duty it is to prevent his tarrying at those places. Our own world—the earth—is an island in the ocean. In the far east a god is sitting, who holds a strong bar in both his hands. Stone ropes are tied to this bar by means of which the earth is held in place. In the far west is the salmon land. The world underneath ours is that of the ghosts. Everything there is the reverse of what it is here. The ghosts walk on their heads. When it is winter here it is summer there, When it is daylight here it is night-time there. The deceased may return to life by being born again. When a ghost dies his soul goes to the lowest world, from which there is no return. The year is divided into two periods. In summer the 'canoe of the salmon' stays in our world. In October it returns to the salmon country and at the same moment the 'canoe of the winter ceremonial' arrives. As soon as this canoe reaches the banks of the river the whole tribe embark and are conveyed to the 'House of Myths,' in heaven. At the same time the female spirit of the winter ceremonial, of which there is one for each village, leaves her abode in the mountains and shows herself. At the time of the winter solstice the 'canoe of the winter ceremonial' returns and the 'canoe of the salmon' arrives from the salmon country. These mythological ideas are the foundation of the calendar of the people, which has twelve months, two indefinite periods around the solstices and five months between the solstices.

The traditions of the Bella Coola are, to a great extent, totemic. Only members of the clan have the right to relate their traditions and to use the carvings based on their traditions. This has led to a system of endogamic marriage which was intended to prevent the acquisition of clan rights by other clans. This system is breaking down under the influence of the Kwakiutl system of exogamic marriage.

Investigations on the art of the Indians were mainly based on the consideration that the process of conventionalization will probably progress the farther the more difficult the treatment of the surface to be decorated. It seemed that no surface offers greater difficulties than the human face, and for this reason a considerable number of facial paintings were collected. The results of this collection met the expectations, since a number of highly conventionalized designs, some of purely geometrical character, were obtained. In addition to these a number of designs from house fronts and from edges of blankets were obtained.

The studies on the languages of the Kwakiutl Indians cannot very well be summarized in a few words. Texts were obtained in two dialects, the Awikyenok and the Kwakiutl proper, which will probably form a satisfactory basis for a full treatment of these dialects.

On account of the difficulties encountered in previous work on the physical characteristics of the tribes, it was deemed desirable to base the work on better material. Previous collections consisted of measurements and brief descriptive notes of types. These latter proved to be very unsatisfactory on account of the vagueness of the terms employed. Photographs obviate this difficulty to a certain extent, but not adequately, owing to the effects of perspective forshortening. For this reason it was deemed desirable to try if the subject can be treated more advantageously by means of a systematic collection of plaster casts, which will facilitate comparison. This seemed particularly important, since the study of the physical types of the coast of the North Pacific Ocean must form one of the most important subjects of investigation of the Jesup Expedition. A series of one hundred casts have been obtained, representing four distinct types of British Columbia. The collection will be subjected to a critical examination in order to ascertain the usefulness of the method of investigation. The collection was made by all the members of the party. Each cast is accompanied by four photographs of the subject on a scale of about 1:5, front view, two profiles and one half profile. These photographs were taken by Mr. Harlan I. Smith.

Dr. Farrand, in his work among the Chilcotin, obtained considerable ethnological information, both as regards mythology and general customs. In both these fields striking evidence of the influence of contact with neighboring tribes was found ; thus in certain myths details of clearly coast origin, along with those bearing unmistakable marks of the interior, were found grafted upon otherwise independent Chilcotin stories. In social organization the Chilcotin, unlike the Tinneh tribes immediately to the north of them, show few signs of coast influence. No traces of clan organization were seen. Recognized relationship was regarded as a bar to marriage, but this recognition was apparently not carried further than cousins of the first degree. The general condition and habits of the tribe have been greatly changed during the last thirty years, owing to the establishment of reservations upon which most of the people have been settled who thus abandoned the wandering life to which they were formerly accustomed. A few families

still decline to come in to the reservations and keep up their old semi-nomadic life in the mountains.

As to the social organization of the Heiltsuk it was found that the tribe contains four clans—the eagle, wolf, raven and killer whale. There is nothing corresponding to the phratries of tribes farther north, but the individual clans are strictly exogamous, and marriage is also forbidden with members of corresponding clans in certain other tribes. Descent is mixed, maternal and paternal, but preference is shown for the clan of the mother. In the case of a single child it almost invariably takes the maternal clan. There were formerly three social classes—nobility, common people and slaves. The nobility or chiefs were of different ranks, higher position being obtained by means of the potlatch. A member of the lower classes, however, could never obtain nobility.

A very considerable number of specimens were collected by the expedition which will materially increase the scientific value of the collections from the North Pacific coast in the American Museum of Natural History. The new material consists mainly of archæological collections from Kamloops, Lytton and Port Hammond; an ethnological collection from Spence's Bridge, another one from Chilcotin Valley. From the northern part of the coast a very full collection of masks and carvings illustrating mythology of the Bella Coola was obtained. Another collection illustrates the arts and ceremonials of the Kwakiutl and of the Nootka. Finally the large collection of casts and photographs of Indians must be mentioned.

Ethnology is deeply indebted to Dr. Jesup for inaugurating this important investigation, which, we may hope, will help to settle finally a number of the most difficult problems regarding the early history of mankind.

*EXPERIMENTAL MORPHOLOGY.**

IN looking at the progress which has been made in the study of plant morphology I have been as much impressed with the different attitudes of mind toward the subject during the past 150 years as by the advance which has taken place in methods of study and the important acquisitions to botanical science. These different view points have coincided to some extent with distinct periods of time. What Sachs in his 'History of Botany' calls the 'New Morphology' was ushered in near the middle of the present century by Von Mohl's researches in anatomy, by Naegeli's investigation of the cell and Schleiden's history of the development of the flower. The leading idea in the study of morphology during this period was the inductive method for the purpose of discerning fundamental principles and laws, not simply the establishment of individual facts, which was especially characteristic of the earlier period when the dogma of the constancy of species prevailed.

The work of the 'herbalists' had paved the way for the more logical study of plant members by increasing a knowledge of species, though their work speedily degenerated into mere collections of material and tabulations of species with inadequate descriptions. Later the advocates of metamorphosis and spiral growth had given an impetus more to the study of nature, though diluted with much poetry and too largely subservient to the imagination or idealistic notions.

But it was reserved for Hoffmeister,† whose work followed within three decades of the beginnings of this period, to add to the

*Address of the Vice-President before Section G—Botany—of the American Association for the Advancement of Science, Detroit, 1897.

† Bibliographical details will be appended when the address is published in the Proceedings of the Association.

inductive method of research as now laid down the comparative method, and extending his researches down into the Pteridophyta and Bryophyta, he not only established for these groups facts in sexuality which Camerarius and Robert Brown had done for the Spermatophyta, but he did it in a far superior manner. He thus laid the foundation for our present conceptions of the comparative morphology of plants. Naegeli's investigations of the cell had emphasized the importance of its study in development and now the relation of cell growth to the form of plant members was carried to a high degree, and an attempt was made to show how dependent the form of the plant was on the growth of the apical cell in the Pteridophyta and Bryophyta, though later researches have modified this view, and how necessary a knowledge of the sequence of cell division was to an understanding of homologies and relationships. Thus in developmental and comparative studies morphology has been placed on a broader and more natural basis, and the homologies and relationships of organs between the lower and higher plants are better understood.

But the growth of comparative morphology has been accompanied by the interpretation of structures usually from a teleological standpoint, and in many cases with the innate propensity of the mind to look at nature in the light of the old idealistic theories of metamorphosis.

I wish now to enquire if we have not recently entered upon a new period in our study of comparative morphology. There are many important questions on which comparative studies of development under natural or normal conditions alone cannot afford a sufficient number of data. We are constantly confronted with the problems of the interpretation of structure and form, not only as to how it stands in relation to structures in other plants which we deal with in comparative morphology, but the meaning of the structure or form itself, and in relation to the other structures of the organism, in relation to the environment and in relation to the past. This must be met by an enquiry on our part as to why the structure or form is what it is, and what are the conditions which influence it. This we are accustomed to do by *experiment*, and it begins to appear that our final judgments upon many questions of morphology, especially those which relate to variation, homology, etc., must be formed after the evidence is obtained in this higher trial court, that of *experimental morphology*. While experimental morphology as a designation of one branch of research in plants, or as a distinct and important field of study, is not yet fully taken cognizance of by botanists, we have only to consult our recent literature to find evidence that this great and little explored field has already been entered upon.

Experimental methods of research in the study of plants have been in vogue for some time, but chiefly by plant physiologists and largely from the standpoint of the physical and chemical activities of the plant, as well as those phases of nutrition and irritability, and of histologic structure, which relate largely to the life processes of the plants, and in which the physiologist is therefore mainly interested. In recent years there has been a tendency in physiological research to limit the special scope of these investigations to those subjects of a physical and chemical nature. At the same time the study of the structure and behavior of protoplasm is coming to be regarded as a morphological one, and while experimental methods of research as applied to the morphology of protoplasm and the cell is comparatively new there is already a considerable literature on the subject, even from the side of plant organisms (Davenport, '97). While certain of the

phenomena of irritability and growth are closely related to the physics of plant life, they are essentially morphologic, and it is here especially that we have a voluminous literature based strictly on the inductions gained by experimentation, and for which we have chiefly to thank the plant physiologists.

If we were to write the full history of experimental morphology in its broadest aspects we could not omit those important experimental researches on the lower plants in determining the ontogeny of polymorphic species among the algæ and fungi which were begun so ably by DeBary, Tulasne, Pringsheim and others and carried on by a host of European and American botanists. The tone which these investigations gave to taxonomic botany has been felt in the study of the higher plants, by using to some extent the opportunities at botanic gardens, where plants of a group may be grown under similar conditions for comparison, and in the establishment of alpine, subalpine and tropical stations for the purpose of studying the influence of climate on the form and variations of plants, and in studying the effect of varying external conditions.

While experimental morphology in its broadest sense also includes in its domain cellular morphology and the changes resulting from the directive or taxic forces accompanying growth, it is not these phases of morphology with which I wish to deal here.

The question is rather that of experimental morphology as applied to the interpretation of the modes of progress followed by members and organs in attaining morphologic individuality, in the tracing of homologies, in the relation of members associated by antagonistic or correlative forces, the dependence of diversity of function in homologous members on external and internal forces, as well as the causes which determine the character of certain paternal or maternal structures. I shall deal more especially with the experimental evidence touching the relation of the members of the plant which has been represented under the concept of the leaf as expressed in the metamorphosis theory of the idealistic morphology. The poetry and mystery of the plant world, which was so beautifully set forth in the writings of Goethe and A. Braun, are interesting and entrancing, and the poetic communication with nature is elevating to our ethical and spiritual natures. But fancy or poetry cannot guide us safely to the court of inquiry. We must sometimes lay these instincts aside and deal with nature in a cold, experimental, calculating spirit.

The beginnings of experimental morphology were made about one century ago, when Knight, celebrated also for the impulse which he gave to experimental physiology, performed some very simple experiments on the potato plant. The underground shoots and tubers had been called roots until Hunter (77) pointed out the fact that they were similar to stems. Knight tested the matter by experiment, and demonstrated that the tubers and undergound stems could be made grow into aërial leafy shoots. This he regarded as indicating a compensation of growth, and he thought farther that a compensation of growth could be shown to exist between the production of tubers and flowers on the potato plant. He reasoned that by the prevention of the development of the tubers the plant might be made to bloom. An early sort of potato was selected, one which rarely or never set flowers, and the shoots were potted with the earth well heaped up into a mound around the end of the shoot. When growth was well started the soil was washed away from the shoot and the upper part of the roots so that the plant was only connected with the soil by the roots. The

tubers were prevented from growing and numbers of flowers were formed. This result he also looked upon as indicating a compensation of growth between the flowers and tubers. While we recognize Knight's experiments as of great importance, yet he erred in his interpretation of the results of this supposed correlation between the tubers and flowers, as Vöchting has shown. By repeating Knight's experiment, and also by growing shoots so that tubers would be prevented from developing, while at the same time the roots would be protected, flowers were obtained in the first case while they were not in the second, so that the compensation of growth, or correlation of growth, here exists between the vegetative portion of the plant and the flowers instead of between the production of tubers and flowers as Knight supposed.

The theory of metamorphosis as expressed by Goethe and A. Braun ('51) and applied to the leaf regarded the leaf as a *concept* or *idea*. As Goebel ('80) points out, Braun did not look upon any one form as the typical one which through transformation had developed the various leaf forms, but each one represented a wave in the march of the successive billows of a metamorphosis, the shoot manifesting successive repetitions or renewals of growth each season, presenting in order the 'niederblätter, laubblätter, hochblätter, kelchblätter, blumenblätter, staubblätter, fruchtblätter. Though it had been since suggested from time to time, as Goebel ('80) remarks, that the foliage leaf must be regarded as the original one from which all the other forms had arisen (though at that time Goebel did not think this the correct view), no research, he says, had been carried on, not even in a single case to determine this point. Goebel plainly showed in the case of *Prunus padus* that axillary buds which under normal conditions were formed one year with several bud scales could be made by artificial treatment to develop during the first year. This he accomplished by removing all the leaves from small trees in April, and in some cases also cutting away the terminal shoot. In these cases the axillary shoot, instead of developing a bud which remained dormant for one year as in normal cases, at once began to grow and developed well-formed shoots. Instead of the usual number of bud scales, there were first two stipule-like outgrowths, and then fully expanded leaves were formed, so that in this case, he says, the metamorphosis of the leaf to bud scales was prevented. For this relation of bud scales to foliage leaves Goebel proposed the term 'correlation of growth' ('80). In the case of *Vicia faba* removal of the lamina of the leaf of seedlings when it was very young caused the stipules to attain a large size and to perform the function of the assimilating leaf. He here points out that experimentation aids us in interpreting certain morphological phenomena which otherwise might remain obscure. He cites the occasional occurrence (Moquin-Tandon) in the open of enlarged stipules of this plant which his experiment aids in interpreting. In the case of *Lathyrus aphaca* the stipules are large and leaf-like, while the part which corresponds to the lamina of the leaf is in the form of a tendril, the correlation processes here having brought about the enlargement of the stipules as the lamina of the leaf became adapted to another function. Kronfeld ('86, '87) repeated some of Goebel's experiments, obtaining the same results, and extended them to other plants (*Pirus malus* and *Pisum sativum*), while negative results attended some other experiments. Hildebrand, in some experiments on seedlings and cuttings, found that external influences affected the leaves, and in some cases, where the cotyledons were cut, foliage leaves appeared in place of the usual bud scales, and in *Oxalis rubella* removal of the

foliage leaf, which appears after the cotyledons, caused the first of the bulb scales, which normally appear following the foliage leaf, to expand into a foliage leaf.

In some experiments on the influence of light on the form of the leaves Goebel ('96) has obtained some interesting results. Plants of *Campanula rotundifolia* were used. In this species the lower leaves are petioled and possess broadly expanded, heart-shaped laminæ, while the upper leaves are narrow and sessile, with intergrading forms. Plants in different stages of growth were placed in a poorly-lighted room. Young plants which had only the round leaves under these conditions continued to develop only this form of leaf, while older plants which had both kinds of leaves when the experiment was started now developed on the new growth of the shoot the round-leaved form. In the case of plants on which the flower shoot had already developed, side shoots with the round leaves were formed. Excluding the possibility of other conditions having an influence here, the changes in the form of the leaves has been shown to be due to a varying intensity of light. The situation of the plants in the open favor this view, since the leaves near the ground in these places are not so well lighted as the leaves higher up on the stem. In this case the effect of dampness is not taken into account by the experimenter, and, since dampness does have an influence on the size of the leaf, it would seem that it might be at least one of the factors here. An attempt was now made to prevent the development of the round leaves on the young seedlings. For this purpose the germinating seeds were kept under the influence of strong and continuous lighting. The round leaves were nevertheless developed in the early stage, an indication that this form of the leaf on the seedling has become fixed and is hereditary. Hering ('96) found that enclosing the larger cotyledon of *Streptocarpus* in a plaster cast, so as to check the growth, the smaller and usually fugacious one grew to the size of the larger one, provided the experiment was started before the small one was too old. Amputation of the large cotyledon gave the same results.

Other experimenters have directed their attention to the effect of light and gravity on the arrangement of the leaves on the stem, as well as the effect of light on the length of the petioles and breadth of the lamina. Among these may be mentioned the work of Weisse ('95), Rosenvinge ('94), and others.

Goebel has shown experimentally that dampness is also one of the external influences which can change the character of xerophyllous leaves. A New Zealand species of *Veronica* of xerophyllous habit and scaly appressed leaves in the seedling stage has spreading leaves with a broad lamina. Older plants can be forced into this condition in which the leaves are expanded by growing them in a moist vessel ('96). Gain, Askenasy and others have shown that dampness or dryness has an important influence in determining the character of the leaves.

The results of the experiments in showing the relation of the leaf to the bud scales Goebel regards as evidence that the foliage leaf is the original form of the two, and that the bud scale is a modification of it.

Treub ('72) conducted some interesting experiments for the purpose of determining the homology of the pappus of the Compositæ. Gall-insects were employed to stimulate the pappus of *Hieracium umbellatum*, and it was made to grow into a normal calyx with five lobes. (A recent letter from Professor Treub states that he later repeated these experiments with other species of Compositæ with like results, but the work was not published.) Kny ('94) found in seedlings and cuttings which he experimented with that, while there was still

stored food available for the roots and shoots, there was little, if any, dependence of one upon the other. Hering ('96) comes to somewhat different conclusions as a result of his experiments, finding that in some cases there was a slight increase of growth, while in others growth of the one was reciprocally retarded when the other was checked in development. Numerous cases of horticultural practice in pollination of fruits show that the form and size of the fruit and of the adjacent parts, as well as the longer or shorter period of existence of the floral envelopes, can be influenced by pollination.

The investigations carried on by Klebs ('96) in the conjugation of *Spirogyra* suggest how experimentation of this kind may be utilized to determine questions which in special cases cannot be arrived at easily by direct investigation. If threads of *Spirogyra varians* which are ready for conjugation are brought into a (0.5%) solution of agar-agar, in such a way that nearly parallel threads lie at a varying distance in their windings, where they are within certain limits, the conjugation tubes are developed and the zygospores are formed; but where the threads lie at too great a distance for the influence to be exerted, the cells remain sterile, and no conjugation tubes are developed. If, now, these threads be brought into a nutrient solution, these cells, which were compelled to remain sterile, grow and develop into new threads, *i. e.*, they take on the vegetative, though they are fully prepared for the sexual function. Strasburger ('97) has pointed out that this may be taken as excluding the possibility of there being a reducing division of the chromosomes during the maturing of the sexual cells, a process which takes place in animals, and that the behavior of *Spirogyra* in this respect agrees with what is known to take place in the higher plants, viz., that the reduction process is not one which is concerned in the maturity of the gametes. The same could be said of *Polyphagus*, in which Nowakowski ('78) found that before the zygospore was completely formed the protoplasm moved out and formed a new sporangium.

In the case of *Protosiphon botryoides* Klebs was also able to compel the parthenogenetic development of the motile gametes, and the same thing was observed in the case of the gametes of *Ulothrix*. If we are justified in interpreting this phenomenon as Strasburger suggests, the evidence which Raciborski ('96) gives as a result of his experiments with *Basidiobolus ranarum* would support the idea that there is no reducing division in the chromosomes before the formation of the nuclei of the gametes. Raciborski found that in the case of the young zygospores of this plant, in old nutrient medium where the fusion of the plasma contents had taken place, but before the nuclei had fused, if they were placed in a fresh nutrient medium the fusion of the nuclei was prevented, and vegetative growth took place, forming a hypha which possessed two nuclei, the paternal one and the maternal one. Raciborski interprets Eidam's ('87) study of the nuclear division prior to the copulation of the gametes as showing that the reducing division takes places here as in the maturation of the sexual cells of animals, and looks upon the premature germination of the zygospore as showing that a paternal and maternal nucleus possesses the full peculiarities of a normal vegetative one. However, we are not justified in claiming a reducing division for the nuclei preceding the formation of the gametes in *Basidiobolus* from the work of Eidam, since he was not able to obtain sufficiently clear figures of the division to determine definitely how many divisions took place, to say nothing of the lack of definite information as to the number of chromosomes. Fairchild ('96)

has recently studied more carefully the nuclear division, but on account of the large number of the chromosomes was not able to determine whether or not a reduction takes place. He points out, as others have done, the similarity in the process of the formation of the conjugating cells of *Basidiobolus* and *Mougeotia* among the *Mesocarpeæ*, and to these there might be added the case of *Sirogonium* in which the paternal cell just prior to copulation undergoes division. The division of the copulation cell in *Basidiobolus*, *Mougeotia*, *Sirogonium*, etc., suggest at least some sort of preparatory act, but whether this is for the purpose of a quantitative reduction of the kinoplasm, as Strasburger thinks sometimes takes place, or is a real reduction in the number of the chromosomes, must be determined by further study, so that the bearing of these experiments on the question of a reducing division must for the time be held in reserve.

One of the very interesting fields for experimental investigation is that of the correlation processes which govern the morphology of the sporophylls (stamens and pistils) of the Spermatophyta. One of the controlling influences seems to be that of nutrition, and in this respect there is some comparison to be made with the correlative processes which govern the determination of sex in plants.

Among the ferns and some others of the Pteridophyta a number of experiments have been carried on by Prantl, Bauke, Heim ('96), Buchtien ('87) and others to determine the conditions which influence the development of antheridia and archegonia. Prantl found that in prothallia of the ferns grown in solutions lacking nitrogen there was no meristem and consequently no archegonia, while antheridia were developed, but if the prothallia were changed to solutions containing nitrogen, meristem and archegonia were developed. All the experiments agree in respect to nutrition; with scanty nutrition antheridia only were developed, while with abundant nutriment archegonia were also developed. Heim studied the influence of light and found that fern prothallia grow best with light of 20%–25%. Exclusion of the ultra violet rays does not affect the development of the sexual organs. He argues from this that the ultra violet rays are not concerned in the elaboration of the material for flower production as Sachs had suggested. In yellow light the prothallia grew little in breadth; they also grew upward, so that few of the rhizoids could reach the substratum. Antheridia were here very numerous. After seven months these prothallia were changed to normal light, and in four months afterward archegonia were developed.

Among the algæ Klebs ('96) has experimented especially with *Vaucheria*, such species as *V. repens* and *V. ornithocephala*, where the antheridia and oogonia are developed near each other on the same thread. With weak light, especially artificial light, the oogonium begins first to degenerate. He never succeeded in suppressing the antheridia and at the same time in producing oogonia.

High temperature, low air pressure or weak light tend to suppress the oogonia, and at the same time the antheridia may increase, so that the number in a group is quite large, while the oogonium degenerates or develops vegetatively. Klebs concludes from his experiments that the causes which lie at the bottom of the origin of sex in *Vaucheria*, as in other organisms, are shrouded in the deepest mystery. In the higher plants a number of experiments have been carried on for the purpose of learning the conditions which govern the production of staminate and pistillate flowers, or, in other words, the two kinds of sporophylls. From numerous empirical observations on

diœcious Spermatophyta, the inference has generally been drawn that nutrition bears an important relation to the development of the staminate and pistillate flowers; that scanty nutrition produces a preponderance of staminate plants, while an abundance of nutrition produces a preponderance of pistillate plants. For a period covering three decades several investigators have dealt with this question experimentally, notably K. Müller ('64), Haberlandt ('75, '77) and Hoffmann ('85). These experiments in general give some support to the inferences from observations, yet the results indicate that other influences are also at work, for the ratios of preponderance either way are not large enough to argue for this influence alone. In a majority of cases thick sowings, which in reality correspond to scanty nutrition, tend to produce staminate plants; while thin sowings tend to produce pistillate plants. In the case of the hemp (*Cannabis sativa*) Hoffmann found that these conditions had practically no influence. He suggests that the character of each may have been fixed during the development of the seed, or even that it may be due to late or early fecundation ('71).

In monœcious plants it has often been observed that pistillate flowers change to staminate ones and *vice versa*, and in diœcious plants pistillate ones sometimes are observed to change to staminate ones (the hemp, for example; see Nagel, 1879). K. Müller ('64) states that by scanty nutrition the pistillate flowers of *Zea mays* can be reduced to staminate ones.

Among the pines what are called androgynous cones have in some instances been observed. In *Pinus rigida* and *P. thunbergii*, for example, they occur (Masters ('68). Matsuda ('92) has described, in the case of *Pinus densiflora* of Japan, pistillate and androgynous flowers, which developed in place of the staminate flowers, and conversely staminate and androgynous flowers in place of pistillate ones. Fujii ('95) has observed that where the pistillate or androgynous flowers of *Pinus densiflora* occur in place of the staminate ones they are usually limited to the long shoots which are developed from the short ones of the previous year. The proximity of these transformed short shoots (Kurztriebe) to injuries of the long ones suggested that the cutting away of the long ones might induce the short ones to develop into long ones and the flowers which were in the position for staminate ones to become pistillate.

Fujii says: "In fact, the injuries producing such effect are frequently given by Japanese gardeners to the shoots of the year of *Pinus densiflora* in their operations of annual pollarding. But the 'Langtrieb' which is transformed from a 'Kurztrieb' of the last year does not necessarily bear female or hermaphrodite flowers in the positions of male flowers." To determine the influence of pollarding of the shoots he carried on experiments on this pine in the spring of 1895. He pollarded the shoots, so as, as he terms it, to induce the nourishment to be employed in the development of the flowers and short shoots near the seat of injury; in other cases one or two shoots were preserved, while all the adjacent shoots of last year's growth at the top of the branch were removed, and, farther, both of these processes were combined. Out of the 45 branches experimented on, and on which there were no signs of previous injury, there were nine pistillate or androgynous flowers in place of staminate ones; in 21 branches with signs of previous injury five were transformed, while in 2,283 not experimented on, and with no signs of previous injury, only seven were transformed. Such abnormal flowers, then, are due largely to the injuries upon the adjacent shoots, and, Fujii thinks, largely to the increased amount of nourishment which is conveyed to them as a result of this.

From the experiments thus far conducted upon the determination of sex in plants or upon the determination of staminate or pistillate members of the flowers, nutrition has at least some influence in building up the nourishing tissue for the two different organs or members. This can in part be explained on the ground that antheridia and staminate members of the plant are more or less short lived in comparison with the archegonia and pistillate members, the latter requiring more bulk of tissue to serve the purpose of protection and nourishment to the egg and embryo. It is thus evident that while some progress has been made in the study of this question we are far from a solution of it. Experiment has proceeded largely from a single standpoint, viz., that of the influence of nutrition. Other factors should be taken into consideration, for there are evidently other external influences and internal forces which play an important rôle, as well as certain correlation processes, perhaps connected with the osmotic activities of the cell sap.

The relation of the parts of the flower to the foliage leaves is a subject which has from time to time called forth discussion. That they are but modifications of the foliage leaf, constituents of the leaf concept, is the contention of the metamorphosis theory, and that the so-called sporophylls are modified foliage leaves, is accepted with little hesitation by nearly all botanists, though it would be very difficult, it seems to me, for any one to present any very strong argument from a phylogenetic standpoint in favor of the foliage leaf being the primary form in its evolution on the sporophyte, and that the sporophyll is a modern adaptation of the foliage leaf. Numerous cases are known of intermediate forms between sporophylls and foliage leaves both in the Spermatophyta and Pteridophyta. These are sometimes regarded as showing reversion, or indicating atavism, or in the case of some of the ferns as being contracted and partially fertile conditions of the foliage leaf. There has been a great deal of speculation regarding these interesting abnormal forms, but very little experimentation to determine the causes or conditions which govern the processes.

In 1894 I succeeded in producing a large series of these intermediate forms in the sensitive fern (*Onoclea sensibilis*). The experiments were carried on at the time for the especial purpose of determining whether in this species the partially developed sporophyll could be made to change to a foliage leaf and yet possess characters which would identify it as a transformed sporophyll. The experiments were carried on where there were a large number of the fern plants. When the first foliage leaves were about 25 cm. high they were cut away (about the middle of May). The second crop of foliage leaves were also cut away when they were about the same height during the month of June. During July, in which time the uninjured ferns were developing the normal sporophylls, those which were experimented upon presented a large series of gradations between the normal sporophyll and fully expanded foliage leaves. Among these examples there are all intermediate stages from sporophylls which show very slight expansions of the distal portion of the sporophyll and the distal portions of the pinnæ, until we reach forms which it is very difficult to distinguish from the normal foliage leaf. Accompanying these changes are all stages in the sterilization of the sporangia (and the formation of prothalloid growths), on some more broadly expanded sporophylls there being only faint evidences of the indusia.

The following year (1895) similar experiments were carried on with the ostrich fern (*Onoclea struthiopteris*) and similar results were obtained. At the time that these experiments were conducted I was unaware of

the experiments performed by Goebel on the ostrich fern. The results he reached were the same; the sporophyll was more or less completely transformed to a foliage leaf. Goebel regards this as the result of the correlation processes, and looks upon it as indicating that the sporophyll is a transformed foliage leaf, and that the experiment proves the reality here of the modification which was suggested in the theory of metamorphosis, and thus the foliage leaf is looked upon by him as the primary form. Another interpretation has been given to these results, viz., that they strengthen the view that the sporophyll, from a phylogenetic standpoint, is primary, while the foliage leaf is secondary. What one interprets as a reversion another regards as indicating a mode of progress in the sterilization of potentially sporogenous tissue and its conversion into assimilatory tissue. It is, perhaps, rather to be explained by the adaptive equipoise of the correlative processes existing between the vegetative and fruiting portions of the plant, which is inherited from earlier times. Rather when spore production appears on the sporophyte could this process be looked upon as a reversion to the primary office of the sporophyte, so that in spore production of the higher plants we may have a constantly recurring reversion to a process which in the remote past was the sole function of this phase of the plant. In this way might be explained those cases where sporangia occur on the normal foliage leaf of *Botrychium*, and some peculiar cases which I have observed in *Osmunda cinnamomea*. In some of the examples of this species it would appear that growth of the leaf was marked by three different periods even after the fundament was outlined, the first a vegetative, second a spore-producing, and third a vegetative again ; for the basal portions of the leaf are expanded, the middle portions spore-bearing, the passage into the middle portions being gradual, so that many sporangia are on the margins of quite well-developed pinnæ. These gradations of the basal part of the leaf, and their relation to the expanded vegetative basal portion, showing that the transition here has been from partially formed foliage leaf to sporophyll after the fundament was established, and later the increments of the vegetative part from the middle toward the terminal portion, as shown by the more and more expanded condition of the lamina and decreasing sporangia, indicate that vegetative forces are again in the ascendency. This suggests how unstable is the poise between the vegetative leaf and sporophyll in structure and function in the case of this species.

For two successive years I have endeavored by experiment to produce this transformation in *Osmunda cinnamomea*, but thus far without sufficiently marked results. The stem of the plant is stout, and this, together with the bases of the leaves closely overlapping, contains considerable amounts of stored nutriment, which make it difficult to produce the results by simply cutting off the foliage leaves. The fact that these transformations are known to occur where fire has overspread the ground, and, as I have observed, where the logging in the woods seriously injured the stools of the plant, it would seem that deeper seated injuries than the mere removal of foliage leaves would be required to produce the transformation in this species. It may be that such injury as results from fire or the severe crushing of the stools of the plant would be sufficient to disturb the equilibrium which existed at the time, that the action of the correlative forces is changed thereby, and there would be a tendency for the partially developed foliage leaves to form sporangia, then when growth has proceeded for a time this balance is again changed.

The theory that the foliage leaves of the

sporophyte have been derived by a process of sterilization, and that the transformation of sporophylls to foliage leaves in an individual indicates the mode of progress in this sterilization, does not necessarily involve the idea that the sporophyll of any of the ferns, as they now exist, was the primary form of the leaf in that species, and that by sterilization of some of the sporophylls, the present dimorphic form of the leaves was brought about. The process of the evolution of the leaf has probably been a gradual one and extends back to some ancestral form now totally unknown. One might differ from Professor Bower in the examples selected by him to illustrate the course of progress from a simple and slightly differentiated sporophyte to that exhibited in the various groups of the Pteridophyta, but it seems to me that he is right in so far as his contention for the evolution of vegetative and assimilatory members of the sporophyte can be illustrated by a comparison of the different degrees of complexity represented by it in different groups, and that this illustrates the mode of progress, as he terms it, in the sterilization of potential sporangenous tissue.

On this point it appears that Professor Bower has been unjustly criticised. The forms selected to illustrate his theory were chosen not to represent ancestral forms, or direct phylogenetic lines, but solely for the purpose of illustrating the gradual transference of spore-bearing tissue from a central to a peripheral position, and the gradual eruption and separation of spore-bearing areas, with the final sterilization of some of these outgrowths.

To maintain that in phylogeny the sporophyll is a transformed foliage leaf would necessitate the predication of ancestral plants with only foliage leaves, and that in the case of these plants the vegetative condition of the sporophyte was the primary one, spore production being a later developed function. Of the forms below the Pteridophyta, so far as our present evidence goes, the sporophyte originated through what Bower calls the gradual elaboration of the zygote. All through the Bryophyta, wherever a sporophyte is developed, spore production constantly recurs in each cycle of the development, and yet there is no indication of any foliar organs on the sporophyte. The simplest forms of the sporophyte contain no assimilatory tissue, but in the more complex forms assimilatory tissue is developed to some extent, showing that the correlative forces which formerly were so balanced as to confine the vegetative growth to the gametophyte, and fruiting to the sporophyte, are later changing; that vegetative growth and assimilation are being transferred to the sporophyte, while the latter still retains the function of spore production, though postponed in the ontogeny of the plant.

If we cannot accept some such theory for the origin of sporophylls and foliage leaves by gradual changes in potentially sporogenous tissue somewhat on the lines indicated by Bower, it seems to me it would be necessary, as already suggested, to predicate an ancestral form for the Pteridophyta in which spore production was absent. That is, spore production, in the sporophyte of ancestral forms of the Pteridophyta, may never have existed in the early period of its evolution and spore production may have been a later development. But this, judging from the evidence which we have, is improbable, since the gametophyte alone would then be concerned in transmitting hereditary characters, unless the sporophyte through a long period developed the gametophyte stage through apospory. Bower says in taking issue with Goebel's statement that the experiments on Onoclea prove the sporophyll to be a transformed foliage leaf: "I assert, on the other hand, that this is not proved, and that a good

case could be made out for priority of the sporophyte; in which event the conclusion would need to be inverted, *the foliage leaf would be looked upon as a sterilized sporophyll.* This would be perfectly consistent with the *correlation* demonstrated by Professor Goebel's experiments, as also with the intercalation of a vegetative phase between the zygote and the production of spores." In another place he says: "To me, whether we take such simple cases as the Lycopods or the more complex case of the Filicineæ, the sporangium is not a gift showered by a bountiful Providence upon pre-existent foliage leaves; the sporangium, like other parts, must be looked upon from the point of view of descent; its production in the individual or in the race may be deferred, owing to the intercalation of a vegetative phase, as above explained; while, in certain cases at least, we probably see in the foliage leaf the result of the sterilization of sporophylls. If this be so, much may be then said in favor of the view that the appearance of sporangia upon the later formed leaves of the individual is a reversion to a more ancient type rather than a metamorphosis of a progressive order."

As I have endeavored to point out in another place, if a disturbance of these correlative processes results in the transference of sporophyllary organs to vegetative ones on the sporophyte "why should there not be a similar influence brought to bear on the sporophyte, when the same function resides solely in the gametophyte, and a disturbing element of this kind is introduced? To me there are convincing grounds for believing that this influence was a very potent, though not the only one in the early evolution of sporophytic assimilatory organs. By this I do not mean that in the Bryophyta, for example, injury to the gametophyte would now produce distinct vegetative organs on the sporophyte, which would tend to make it independent of the gametophyte. But that in the bryophyte-like ancestors of the pteridophytes an influence of this kind did actually take place, appears to me reasonable.

"In the gradual passage from an aquatic life, for which the gametophyte was better suited, to a terrestrial existence, for which it was unadapted, a disturbance of the correlative processes was introduced. This would not only assist in the sterilization of some of the sporogenous tissue, which was taking place, but there would also be a tendency to force this function on some of the sterilized portions of the sporophyte, and to expand them into organs better adapted to this office. As eruptions in the mass of sporogenous tissue took place and sporophylls were evolved, this would be accompanied by the transference of the assimilatory function of the gametophyte to some of these sporophylls."

Because sporophytic vegetation is more suited to dry land conditions than the gametophytic vegetation, it has come to be the dominating feature of land areas. Because the sporophyte in the Pteridophyta and Spermatophyta leads an independent existence from the gametophyte, it must possess assimilatory tissue of its own, and this is necessarily developed first in the ontogeny, but it does not necessarily follow, therefore, that the foliage leaf was the primary organ in the phylogeny of the sporophyte. The provision for the development of a large number of spores in the thallophytes, so that many may perish and still some remain to perpetuate the race, is laid hold on by the bryophytes where the mass of spore-bearing cells increases and becomes more stable, for purposes of the greatest importance. Instead of perishing, some of the sporogenous tissue forms protecting envelopes, then supporting and conducting tissue, and finally, in the pteridophytes and spermatophytes, nutritive and assimilatory structures are developed. Nature is prodi-

gal in the production of initial elementary structures and organs. But while making abundant provision for the life of the organism through the favored few, she has learned to turn an increasing number of the unfavored ones to good account. Acted upon by external agents and by internal forces, and a changing environment, advance is made step by step to higher, more stable and prolonged periods.

While we have not yet solved any one of these problems, the results of experimental morphology are sufficient to indicate the great importance of the subject and the need of fuller data from a much larger number of plants. If thus far the results of experiments have not been in all cases sufficient to overthrow the previous notions entertained touching the subjects involved, they at least show that there are good grounds for new thoughts and new interpretations, or for the amendment of the existing theories. While there is not time for detailing, even briefly, another line of experiment, viz, that upon leaf arrangement, I might simply call attention to the importance of the experiments conducted by Schumann and Weisse from the standpoint of Schwendener's mechanical theory of leaf arrangement ('78). Weisse ('94) shows that the validity of the so-called theory of the spiral arrangement of the leaves on the axis may be questioned, and that there are good grounds for the opening of the discussion again. It seems to me, therefore, that the final judgment upon either side of all these questions cannot now be given. It is for the purpose of bringing fresh to the minds of the working botanists the importance of the experimental method in dealing with these problems of nature that this discussion is presented as a short contribution to the subject of experimental morphology of plants.

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PHYSIOLOGY AT THE BRITISH ASSOCIATION.

DURING the Toronto meeting of the British Association for the Advancement of Science the Section in Physiology held seven sessions under the presidency of Professor Michael Foster (Cambridge). The sessions were held in the Biological Building of the University of Toronto, and forty-one papers and demonstrations were presented. The proceedings began upon Thursday, August 19th, with the admirable address of the President, which will be printed in a future number of SCIENCE. The sectional papers of that day related in general to the subject of motion. Professor H. P. Bowditch (Harvard) discussed the rhythm of smooth muscles. Rings from the frog's stomach, when suspended, exhibit sooner or later spontaneous contractions, which continue for from forty-five minutes to twenty-four hours. The graphic curve of such contractions seems to be compound, being formed by the superposition of two waves, which represent two rhythmic contractions of different rates. Sets of contractions are also repeated rhythmically. Professor G. C. Huber (Michigan) gave the results of further researches on the innervation of motor tissues with especial reference to nerve-endings in the sensory muscle-spindles. The main points in this paper are given in SCIENCE, Vol. V., p. 908. Mr. O. F. F. Grünbaum (Cambridge) demonstrated by lantern slides the muscle-spindles in pathological conditions. Professor F. S. Lee (Columbia) discussed the ear and the lateral line in fishes. These two organs are equilibrative in function, and the former is probably the phylogenetic derivative of the latter. Audition in the customary sense of the word is wanting in fishes, and first appears with the change from an aquatic to a land existence. Professor W. P. Lombard (Michigan) spoke on the effect of the frequency of excitations on the contractility of muscles. Dr. J. H.

Kellogg reported the results of a dynamometric study of the strength of the several groups of muscles and the relation of the corresponding homologous groups of muscles in man.

The session of Friday morning, August 20th, was devoted mainly to the presentation of papers on the circulation. Professor G. N. Stewart (Western Reserve) gave a large number of measurements of the output of the mammalian heart examined by a new method. Professor W. T. Porter (Harvard) reported his observations on the mammalian heart concerning the cause of the heart-beat, fibrillary contractions, the influence of ventricular systole on the blood-flow through the heart-muscle, and the circulation through the veins of Thebesius. (See SCIENCE, p. 905, 906.) Professor Karl Hürthle (Breslau) discussed the resistance of the vascular channels. Resistance depends on two factors—the internal friction of the blood and the dimensions of the tubular system. Measurements of the former by the author's method give the result: internal friction of distilled water at 37°C.: that of blood : : 1 : 4.5 (dog), 4.1 (cat), 3.2 (rabbit). From this and certain other data, the author calculates the resistance expressed in terms of the dimensions of a tube through which, under the given conditions, the same quantity of blood could flow. The resistance through the several organs and over the entire vascular course is now being measured. Dr. W. H. Gaskell (Cambridge) gave a comparative résumé of the physiology of the cardiac branches of the vagus nerve in the five main divisions of the vertebrates. Professor A. R. Cushny (Michigan) discussed rythmical variations in the strength of the contractions of the mammalian heart. Professor W. H. Thompson (Belfast) presented a report upon the physiological effects of peptone and its precursors when introduced into the circulation. The research is in the hands of a committee consisting of Professors Schäfer, Sherrington, Boyce and Thompson, and the work of the past year has been carried on by Professor Thompson. The effects of Witte's peptone, pure peptone, anti-peptone and deutero-albumose were given in detail. Professor E. W. Reid (Dundee) presented the results of experiments on the absorption of serum in the intestine. Water and organic and inorganic solids are absorbed against an excess of hydrostatic pressure in the blood-vessels. The results seem to exclude explanation by osmosis, filtration into capillaries or lacteals, imbibition, electro-osmotic action, and aspiration by the blood-current.

In the afternoon of Friday Professor Anderson Stuart (Sidney) spoke upon a newly discovered function of the canal of Stilling in the vitreous humor in receiving lymph during the accommodation of the eye. Professor Stuart also described a number of simple pieces of physiological apparatus which he had found useful for demonstrative purposes. Dr. Noel Paton (Edinburgh) discussed the phosphorus metabolism of the salmon in fresh water, with especial reference to the diminution of phosphorus in the muscle and its increase in the reproductive organs. The loss of phosphorus from the muscle is barely sufficient to account for the gain in the ovary, and amply sufficient for the gain in the testis. But the phosphorus compounds—chiefly lecithin and ichthulin in the ovary and nuclein in the testis—must be formed synthetically. Lecithin is probably one of the first stages in the construction of nucleo-compounds. Professor J. Loeb (Chicago) demonstrated and discussed certain electrostatical stimulative effects upon nerves, which might be mistaken for electro-magnetic effects. Professor G. Lusk (Yale) gave the results of experiments on the gastric inversion of cane sugar by hydrochloric acid, which show that the acidity of the

gastric juice is sufficient to produce such inversion as takes place in the stomach.

The section held no session on Saturday, the majority of the members making the excursion to Niagara.

Monday forenoon was devoted to the subject of neurology. Professor Carl Huber (Michigan) gave an account of his study of the comparative histology of the cells of the sympathetic nervous system. (See SCIENCE, Vol. V., p. 132.) Dr. J. J. Mackenzie (Toronto) spoke on the microchemistry of nerve-cells. Mr. W. B. Warrington gave the details of an investigation of the changes in nerve-cells in various pathological conditions, the latter being caused by various organic poisons, anæmia, the division of peripheral nerves, and the division of the posterior roots. Professer A. Waller (London), who is a member of the committee previously appointed by the Association to investigate the changes which are associated with the functional activity of nerve-cells and their peripheral extensions, and who has been working upon the electro-physiology of isolated nerve, made an elaborate and valuable roport upon the action of acids, alkalies, carbonic acid, tetanization and temperature upon electrotonic currents in nerve. Such currents are physiological, as well as physical. Normally the anodic current (A) is greater than the kathodic (K), in the proportion of 4 or 5 to 1. Rise of temperature to 40° causes diminution of A and increase of K. K is favored by acidification and tetanization, disfavored by basification; alterations of A are less uniform and characteristic. Tetanization and CO_2 have similar effects upon the electrotonic currents. In Dr. Waller's opinion this proves that the tetanization of an isolated nerve gives rise to a production of CO_2. In view of the impossibility heretofore of obtaining any evidence whatever of metabolism in an acting nerve, this conclusion is most important and suggestive, as bearing upon the nature of the nerve impulse. During the presentation of Dr. Waller's paper Miss Welby demonstrated the method used in his laboratory of applying anæsthetics to isolated tissues, employing for the purpose cardiac muscle. Professor Charles Richet (Paris) announced his discovery of a refractory period in the cerebral and medullary nervous centers of the dog. If these be rhythmically stimulated they will respond to either every stimulus or only every other one, according to the temperature and rate of excitation. The duration of the period is 0.1″ at 30° C. Man has a refractory period, since he cannot think at a greater frequency than 10 to 12 per second. Hence the psychological unit of time, or the elementary period of consciousness, is about 0.1″, which, therefore, represents the duration of vibration of the nerve-center.

Monday afternoon was given up to demonstrations. Professor W. P. Lombard (Michigan) showed a cheap and simple chronograph. Professor C. S. Sherrington (Liverpool) demonstrated various new facts regarding visual contrast and flicker. Professor A. B. Macallum (Toronto) showed microscopic specimens illustrating the distribution of iron in cells, and Professors W. A. Herdman and R. Boyce (Liverpool) microscopic specimens illustrating the presence of copper in cells.

On Tuesday morning the Sections in Physiology and Botany held a combined meeting to discuss the chemistry and structure of the cell. This attracted a considerable audience and was one of the most interesting of the sessions. The discussion was opened by Professor R. Meldola (London), who spoke on the rationale of chemical synthesis. Comments were made by Professors J. R. Green (Cambridge), W. D. Halliburton (London), I. Remsen (Johns Hopkins), H. Marshall Ward (Cambridge), and H. E. Armstrong (London). Professor J. R. Green (Cambridge) presented experi-

mental evidence of the existence in yeast of an alcohol-producing enzyme. Professor A. B. Macallum (Toronto) presented certain new views on the significance of intracellular structures and organs. According to him the centrosphere is the oldest part of the cell. The nucleus and the cytoplasm are secondary structures. This explains the fact that in cell-division the division of the centrosome precedes that of the rest of the cell. These views were opposed by Mr. H. Wager (Leeds), who gave strong evidence for the presence of a nucleus in the yeast-cell, and by Professor J. B. Farmer (London).

The final session was held on Wednesday forenoon and was devoted to psychological and miscellaneous papers. Professor W. D. Halliburton (London), on behalf of himself and Dr. Mott, discussed the action of cholin, neurin and allied substances on the circulation, in connection with the discovery by them, in the cerebro-spinal fluid in certain forms of insanity, of a substance which appears identical with cholin and depresses blood-pressure by acting upon the heart. Professor R. Boyce (Liverpool), on behalf of himself and Professor W. A. Herdman (Liverpool), discussed the presence of copper in animal cells. Papers were read by Dr. T. W. G. McKay on intestinal absorption of hæmoglobin and ferratin, by Mr. R. R. Bensley (Toronto) on the morphology and physiology of gastric cells, and by Mr. O. F. F. Grünbaum (Cambridge) on visual reaction to intermittent stimulation. Professor Wesley Mills (McGill) discussed the functional development of the cerebral cortex in different groups of animals (see SCIENCE, Vol. V., p. 134), and the psychic development of young animals. In the latter paper he presented the results of a correlation of the psychic development of the dog, cat, rabbit, guinea-pig, rat, and bird with the development of the cortical centers. Professor C. Lloyd Morgan (Bristol) read a suggestive paper on the physiology of instinct. The essential part of the objective aspect of instinctive activity is the coordination of outgoing impulses. This activity is at first unconscious, but later, by the coming in of afferent impulses, consciousness may appear. Professor L. Witmer (Pennsylvania) discussed the nature and physical basis of pain. Pain is a sensation, the central organ of which consists of the sensori-motor centers; no special pain nerves exist.

On account of the full program comparatively little general discussion of the papers was possible, and this constituted the one drawback of the meeting. The sectional committee, the membership of which has already been printed in SCIENCE, p. 335, held daily sessions, and the usual grants for research were asked for.

FREDERIC S. LEE.

COLUMBIA UNIVERSITY.

THE PATAGONIAN EXPEDITION FROM PRINCETON UNIVERSITY.

THIS expedition, dispatched to Patagonia from Princeton University in February, 1896, returned during August. It was under the auspices of Professor W. B. Scott, of the Department of Geology, and had for its object the collecting of vertebrate fossils from the Tertiary deposits, and the skins and skeletons of recent birds and mammals. It was directly in charge of Mr. J. B. Hatcher and his assistant, Mr. O. A. Peterson.

The objective point was the Port of Gallegos, on the east coast of southern Patagonia, which was reached April 29, 1896. From this point investigations were conducted, first along the coast from Sandy Point, in the Straits of Magellan, to Port Desire, on the north. In this region many interesting fossil forms were secured and a nearly complete series of living birds, mammals and plants. After spending several

months in the coast region, an expedition was made into the interior, into the little known lake region about the head waters of the Santa Cruz river and to the northward into an absolutely unknown region of the Cordilleros. Here many new glaciers were discovered and important water courses located.

The time spent in this region was most enjoyable, and the results there attained contributed even more to the success of the trip than those nearer the coast. Being an unexplored country not only were new facts relating to the geography of the region discovered, but many animals and plants new to science were also collected; and the series of observations made, and facts obtained, relating to the age of the Cordilleros and other geological phenomena of the entire region, are of the greatest value. Scattering over the plains region of the interior were found numerous volcanic cones hitherto unreported which were shown to have been the source of the great lava beds which in many places are spread in great sheets over the surface of the country.

On account of the difficult travelling and the length of time consumed on this trip into the interior, it was absolutely impossible to take any great supply of provisions, so that it became necessary to limit the personnel of the expedition to Messrs. Hatcher and Peterson, who were gone five months on this trip, during which time not only was it impossible for them to receive or dispatch any mail, but they never met with or saw a single human being but their two selves.

The result of the work done in Patagonia may be briefly summarized as follows:

The discovery of many new facts relating to the geography of the region.

The discovery of several geological horizons new to Patagonia.

The making of a complete geological section from the igneous rocks forming the mass of the Cordilleros to the uppermost Tertiary rocks, and extending from the Cordilleros to the Atlantic coast.

The collecting of a nearly complete series of the mosses, hepatical and flowering plants, not including grasses; of some 800 skins and skeletons of recent birds and animals and about eight tons of fossils, including more than 1,000 skulls and many nearly complete skeletons—altogether, the most valuable collection from that region to be found anywhere in the world.

After spending a little more than a year on the mainland, the expedition proceeded to Tierra del Fuego and the adjoining islands, where important collections were also made, especially of the plants of that archipelago, and observations were made concerning the geology and paleontology of the islands, which it is believed will be of considerable importance. Some attention was also given to the Indians of this region, especially of the Channel and Canoe Indians, who live almost entirely in frail boats of their own manufacture and subsist wholly upon shell fish, which they are able to pick up in great abundance along the shore. The great accumulation of shell heaps observed at certain points along the shores is believed to point to a great antiquity for this exceedingly primitive tribe.

Throughout their work the Argentine government was very generous and courteous to the expedition, giving to its members transportation on its war vessels from Buenos Aires to Gallegos and return, and offering to place at its disposal a smaller vessel for use in researches among the islands.

SCIENTIFIC NOTES AND NEWS.

GRANTS FROM THE BRITISH ASSOCIATION FOR SCIENTIFIC RESEARCH.

As we have already noted, the British Association appropriated at the Toronto meeting £1,350 (more than $6,500) to committees for

scientific work. The sum was larger than usual, as the the large attendance at the Liverpool meeting left a surplus, and it was wished to favor this year the inauguration or continuation of special work in Canada. It is with reluctance that we state for comparison that last year the American Association appropriated $200 and this year $100 for scientific work. It should be remembered that such appropriations not only contribute greatly to the advancement of science, but also add much to the interest of the meetings at which the reports of the committees are presented.

The responsible member of the committee, the subject of the work and the amount in pounds each of the appropriations is as follows:

	£
Mathematics and Physics.—Professor Carey Foster: Electrical Standards	75 0 0
Mr. G. J. Symons: Seismological Observations	75 0 0
Dr. E. Atkinson: Abstracts of Physical Papers	100 0 0
Rev. R. Harley: Calculation of Certain Integrals	20 0 0
Mr. W. N. Shaw: Electrolysis and Electrochemistry	35 0 0
Professor H. L. Callendar: Meteorological Observatory at Montreal	50 0 0
Chemistry.—Sir H. E. Roscoe: Wave-length Tables of the Spectra of the Elements	20 0 0
Professor J. Emerson Reynolds: Electrolysis Quantitative Analysis	12 0 0
Dr. T. E. Thorpe: Action upon Light Dyed Colours	8 0 0
Sir J. Evans: Promotion of Agriculture	5 0 0
Geology.—Professor E. Hull: Erratic Blocks	5 0 0
Professor T. G. Bonney: Investigation of a Coral Reef	40 0 0
Sir W. H. Flower: Fauna of Singapore Caves (unexpended balance in hand, 40*l.*)	—
Professor J. Geikie: Photographs of Geological Interest	10 0 0
Mr. J. E. Marr: Life-zones in British Carboniferous Rocks (unexpended balance in hand)	—
Professor W. Boyd Dawkins: Remains of the Irish Elk in the Isle of Man (unexpended balance in hand)	—
Mr. T. F. Jamieson: Age of Rocks near Moreseat	10 0 0
Sir J. W. Dawson: Pleistocene Fauna and Flora in Canada	20 0 0
Zoology.—Professor W. A. Herdman: Table at the Zoological Station, Naples	100 0 0
Mr. G. C. Bourne: Table at the Biological Laboratory, Plymouth	20 0 0
Sir W. H. Flower: Index Generum et Specierum Animalium	100 0 0
Professor L. C. Miall: Biology of the Lakes of Ontario	75 0 0
Professor W. A. Herdman: Healthy and Unhealthy Oysters	30 0 0
Geography.—Mr. E. G. Ravenstein: Climatology of Tropical Africa	10 0 0
Economic Science and Statistics.—Professor H. Sidgwick: State Monopolies in other Countries	15 0 0
Mr. L. L. Price: Future Dealings in Raw Produce	10 0 0
Mechanical Science.—Mr. W. H. Preece: Small Screw Gauge	20 0 0
Anthropology.—Professor E. B. Tylor: Northwestern Tribes of Canada	75 0 0
Dr. R. Munro: Lake Village at Glastonbury	37 10 0
Mr. E. W. Brabrook: Ethnographical Survey (and unexpended balance in hand)	25 0 0
Mr. A. J. Evans: Silchester Excavation	7 10 0
Dr. G. M. Dawson: Ethnological Survey of Canada	75 0 0
Sir W. Turner: Anthropology and Natural History of Torres Strait	125 0 0
Physiology.—Dr. W. H. Gaskell: Investigation of Changes associated with the Functional Activity of Nerve Cells and their Peripheral Extensions	100 0 0
Botany.—Professor J. B. Farmer: Fertilization in Phæophyceæ	15 0 0
Corresponding Societies.—Professor R. Meldola: Preparation of Report	25 0 0

THE NEW YORK BOTANICAL GARDEN.

THE New York City Board of Estimate and Apportionment gave a public hearing on September 29th in the matter of the appropriation for the Bontanical Museum for the Botanical Garden in Bronx Park. Some persons have been objecting to the plans approved by the Park Board, but in the public hearing they only took exception in a general way to the use of a portion of a Park for a Botanical Garden. The Board of Estimate and Appropriation unanimously passed a resolution granting the appropriation, after listening to a statement from the trustees, which was as follows:

"The establishment of a Botanical Garden in the city of New York has been actively prosecuted since the year 1889, the necessary legislation having been obtained in an act passed in 1891 and amended in 1894 and 1896. The project through all this period received most cordial support from the city officials and from the public. The present Board of Managers was organized on March 21, 1895, and on June 18, 1895, the condition of the act of incorporation requiring the subscription of $250,000 was fully met. At a meeting of the managers, held on that date, a special committee of five members was appointed a committee on plans, and this committee has been since continued. The securing of the necessary $250,500 as a subscription fund was reported to the Commissioners of Parks, as authorized and directed by the act of incorporation, and the selection of site was duly accepted by the Board of Managers. On October 30, 1895, the present Board of Estimate and Apportionment authorized the issue of bonds to an amount not exceeding $25,000 for surveys, plans, etc.; but these have not been issued. Prior to the organization of the Board of Managers, many of the members of the corporation had given continuous study to the project since its inception. Several of them have made critical studies of botanical gardens in the Old World.

"The committee on plans, appointed in June, 1895, studied the subject in all its aspects for a year, with the aid of advice and suggestion from many botanists, landscape gardeners, architects, and others interested, in this country and in Europe, and determined the principal ends desirable to be reached, and the most economic, artistic and practical methods of reaching them, having always in mind the beautiful features of the grounds and the great value of these to the institution; their preservation has been determined on from the very first. On June 17, 1896, the preparation of a general plan to embody the results reached after this long and careful consideration was referred to a commission of experts, consisting of N. L. Britton, director-in-chief; R. W. Gibson, architect; John R. Brinley, civil and landscape engineer; Lucien M. Underwood, professor of botany, Columbia University; Samuel Henshaw, landscape gardener; Lincoln Pierson, secretary Lord & Burnham Company, greenhouse architects. All these are men well and favorably known in their professions, and it is maintained that in this commission were included all the elements necessary or desirable for the purpose of the general study, the determination of the detailed landscape treatment and special planting being wisely deferred until the general scheme had been approved; these will be taken up under the best advice obtainable."

GENERAL.

THE Eighth International Geological Congress will meet in Paris in 1900. In 1903 the place of meeting will be Vienna.

THE New York Academy of Sciences is in great need of a building for its meetings, for its library and as a center for the scientific life of the city. A university lecture room has not been a satisfactory place of meeting, and in view of the removal of Columbia University the Academy will this year meet at the Mott Memorial Library, 64 Madison Avenue. Visitors interested in the subjects presented are welcomed at the meetings, and citizens of New York should remember that the sections meet on Monday evenings as follows: Section of Astronomy and Physics, first Monday of the month; Section of Biology, second Monday; Section of Geology and Mineralogy, third Monday; Sections of Psychology, Anthropology and Philology, fourth Monday.

OF the other societies composing the Scientific Alliance of New York the Torrey Botanical Club will meet at the College of Pharmacy, the Linnæan Society and the Entomological Society at the American Museum of Natural History, the Chemical Society at the College of the City of New York, and the Mineralogical Club and the Microscopical Society at the Mott Memorial Library.

THE New York Section of the American Chemical Society will hold its annual meeting on October 15th. Officers for the ensuing year will be elected and the retiring President, Dr. Wm. McMurtrie, will make an address on 'Some Records of Recent Progress in Industrial Chemistry.' A special meeting of the Society was held on the evening of October 1st, in honor of Professor Henry E. Armstrong, of London, who came to this country to take part in the meeting of the British Association. An address was made by Dr. H. Carrington Bolton.

THE first section of the Brooklyn Museum of Arts and Sciences was dedicated on October 2d. Addresses were made by the President of the Board of Trustees, Mr. A. A. Healy, and by the Director of the Institute, Professor Franklin W. Hooper, by Mayor Wurster, of Brooklyn, and by President Eliot, of Harvard University,

who spoke on 'The Functions of Education in Democratic Society.' The present building, which is already crowded by the collections of art and natural history, was informally opened at the beginning of June, and was visited during August by 12,000 persons. The building as projected will be thirty-two times as large as the present structure, erected by the city of Brooklyn as one of its last public works at a cost of $300,000. The charter of the combined cities composing New York at the beginning of next year provides for the liberal maintenance of the Brooklyn Institute, which will be one of the chief centers of art, science and culture in the great city.

IN his address at the recent meeting of the Associated Chambers of Commerce, Sir Courtney Boyle announced his intention of establishing a museum of samples in connection with the British Board of Trade. The scope and objects of the museum would be similar to those of the recently established commercial museums at Philadelphia.

THE sum of £442 has been collected in British India as a contribution to the Pasteur Memorial Fund.

THE Maharaja of Patiala has presented the Indian government with a site for the Pasteur Institute to be established at Simla.

THE American Public Health Association will hold its twenty-fifth annual meeting at Philadelphia from the 26th to the 29th of October.

A SCHOOL of ethics and social philosophy has been formed in London, with a general committee including the Master of Balliol, Mr. Leslie Stephen, Mr. R. B. Haldane, Mr. W. L. Courtney, Professor Sully and Mrs. Bryant. The aim of the new school is to approach social questions from the side of psychology and ethics. Lectures have been promised by Professor Henry Sidgwick, Mr. Sidney Webb, Mr. F. W. H. Myers, Mr. Bosanquet, Professor Lewis Campbell and others.

THE first installment of a card catalogue of the New York Public Library was put in use at the Astor Library this week. Some twenty-five assistants are working under Dr. Billings on the catalogue, and it is hoped that it will be completed in about three years.

THE prize lists of the Institution of Civil Engineers for the session of 1896-97 awards the Howard prize of 50 guineas to Mr. Hilary Bauerman, in recognition of his work on the metallurgy of iron. For original papers presented to the Institution, Telford medals, with premiums of books or instruments, are awarded to Messrs. H. A. Humphrey, for 'The Mond Gas-Producer Plant and its Application;' to Colonel Pennycuick, R.E., for 'The Diversion of the Parivar;' to Mr. E. C. Shankland, for 'Steel Skeleton Construction in Chicago;' to Mr. Dugald Drummond, for 'High Pressure in Locomotives;' and to Mr. Thomas Holgate, for 'The Enrichment of Coal Gas.' George Stephenson medals and Telford premiums are awarded to Mr. Cruttwell, for 'The Tower-bridge Superstructure,' and to Professor Unwin, for 'A new Indentation Test for Determining the Hardness of Metals;' Watt medals and Telford premiums to Messrs. Hay and Fitzmaurice for their joint paper on 'The Blackwall Tunnel.'

THE Royal Society of New South Wales offers its medal and ten guineas for the best communication (provided it be of sufficient merit) containing the result of original research or observations on the following subjects; 'On the Iron-ore deposits of New South Wales' (time limit, May 1, 1898); 'On the Life History of the Australian Teredo and other specimens of Australasian wood-eating Marine Invertebrata, and on the means of protecting timber from their attacks' (time limit, May 1, 1899). The competition is not confined to members of the Society, nor to residents in Australia. The Society is fully sensible that the money value of the prize will not repay an investigator for the expenditure of his time and labor, but it is hoped that the honor will be regarded as a sufficient inducement and reward.

THE United States Civil Service Commission announces that on October 25, 1897, it will hold examinations to establish a register from which selections may be made to fill numerous minor vacancies in special and technical positions in the government service. A list of the examinations which will be held, and of the cities at which they may be taken, will be furnished on request.

SECRETARY WILSON, of the Agricultural Department, will, in his annual report, ask Congress to make an increase in the appropriation for the Bureau of Animal Industry, the Farmers' Bulletins and the Weather Bureau.

PROFESSOR WIESNER, of Vienna, has undertaken during the past summer, says *Nature*, a journey to Spitsbergen to complete his observations, previously made in the Tropics, as to the effect of light and other external conditions on the growth of plants.

THE members of the Stanford University party who have been engaged in branding seals by electricity on Pribyloff Islands have, as we learn from the daily press, arrived at Palo Alto. They claim that the experiment was successful. Besides the work of taking the seal census and building a fence enclosing the salt lagoon to prevent the redriving of bachelor seals, a number of bird skins, skeletons, insects and marine invertebrates were collected. The party consisted of Messrs. Greely, '98; Snodgrass, '99; Edwards, 1900; Bristow and Adams, 1900, and Instructor Farmer.

WE learn from the London *Times* that Miss Ormerod, of Torrington-house, St. Albans, continues to supply the leaflet on the common sparrow, and that several of the largest British landowners are interesting themselves in the endeavor to reduce the numbers of *Passer domesticus* to within reasonable limits. Since attention was first drawn to the matter a few weeks ago Miss Ormerod has received applications for the pamphlet from most unexpected places—Stavanger, St. Petersburg and Smyrna, for example. So great is the demand that yet another edition of 5,000 copies has been printed. Miss Ormerod sends the pamphlet free on a receipt of a stamp for postage and many copies should find their way to America.

A DESPATCH to the daily papers from Bombay states that the latest health statistics show that the bubonic plague is again active, having crept unobserved from hamlet to hamlet until a wide area is affected. The newspapers assert that the withdrawal of the medical officers for service with the troops on the frontier will entail consequences more disastrous than anything happening on the frontier.

AS we learn from *Nature*, the Commission du Musée d'Histoire Naturelle at Geneva has formed itself into a committee having for its object the erection of a monument to the memory of François Jules Pictet de la Rive. A site for the monument has been granted in front of the museum. Old students of the eminent investigator, and all who are interested in the work which he accomplished, are invited to send subscriptions for the memorial fund to MM. Lombard, Odier et Cie, Genève.

THE Icelandic Parliament has voted a subsidy for the laying of a cable from Scotland to Iceland by way of Faroe Islands. The Great Northern Telegraph Company will lay the cable during the early summer next year.

A REFUGEE hut on the Zugspite, the highest mountain in Germany (10,000 feet), near Garmisch, in the center of the Bavarian Highlands, has been opened. It stands on the Grat between the east and west peaks, affords accommodations for twenty-two guests, and has been erected at a cost of $10,000.

WITH the beginning of the next volume in January *The American Naturalist* will be published by Ginn & Co., Boston, New York and Chicago.

THE government of India and Lord George Hamilton have offered hearty congratulations to Sir Joseph Hooker on the occasion of the completion of the 'Flora of British India,' on which he has been engaged for twenty-five years. Sir Joseph will now undertake to complete the 'Flora of Ceylon,' left unfinished by the death of Dr. Trimen.

WE have received from John P. Morton & Son, Louisville, a guide to the Mammoth Cave, of Kentucky, by Horace C. Hovey and R. Ellsworth Call. Both of the authors have for years been familiar with the Mammoth Cave and have published works on American caverns. It is a great advantage to have a guide book by men of science, written with accuracy and without exaggeration. Visitors to the cave using this book will learn much of its geology and natural history, and it will also prove useful to those who are studying the scientific problems involved.

THE three leading articles of the October *Monist* deal with questions of evolution. The

first is a posthumous essay by the late George J. Romanes on 'Isolation as a Factor of Organic Evolution,' wherein Mr. Romanes discusses the contributions of Mr. Gulick to the theory of development, and gives it as his opinion that isolation is to be ranked with heredity and variability as 'the third pillar of a tripod on which is reared the whole superstructure of organic evolution.' He contends that even the principle of natural selection lies less deep, and makes of the latter a special case of isolation. Mr. Romanes also discusses his own doctrine of physiological selection. The second article, by Professor Eimer, of Tübingen, on 'The Origin of Species,' gives a concise digest of his views of evolution and exemplifies them by material and illustrations from his new forthcoming researches on butterflies. Eimer explains the origin of species, (1) by cessation of development at definite stages, (2) by evolution *per saltum*, and (3) by prevention of impregnation, which is similar to Romanes's physiological selection. He accords to natural selection a subordinate rôle only, having efficacy in the preservation but not in the origination of species. The transmutation of forms is controlled by orthogenesis, or definite development, and not by chance variation. The article is substantially Professor Eimer's Leyden address, which has not yet appeared in German. The third article is by Dr. Paul Topinard, and constitutes part of his series 'Man As a Member of Society,' in which the French anthropologist traces the influence of the factors which have affected social development from the beginning of civilization to its highest consummation.

THE following field meetings have been arranged by the Torrey Botanical Club, of New York:

Oct. 2d.—Mosholu, N. Y., N. Y. & P. R. R. Leave 155th St. (Ninth and Sixth Ave. Terminal, Manhattan Elevated R. R.) at 9:30 a. m. Returning, leave Mosholu at 12:37 p. m., or as desired. Object: Asters and Goldenrods. Excursion fare, 30 cts. Guide, Professor Burgess.

Oct. 9th.—Woodhaven, Long Island, L. I. R. R. Leave foot E. 34th St. at 1:30 p. m. Returning, leave Woodhaven as desired. Excursion fare, 35 cts. Guide, Mr. Hulst.

Oct. 16th.—Caryl, N. Y., N. Y. & P. R. R. Leave 155th St. at 1:00 p. m. Returning, leave Caryl at 5:17 or 5:47. Excursion fare, 30 cts. Guide, Mr. Constantine.

Oct. 23d.—Tarrytown and Sleepy Hollow, N. Y., N. Y. C. & H. R. R. R. Leave Grand Central Station at 1:00 p. m. Returning, leave Tarrytown at 5:37 p. m. Excursion fare, $1.00 Guide, Dr. Barnhart.

Oct. 30th.—Fort Lee, N. Y. Leave foot of 125th St. at 1:00 p. m. Returning as desired. Fare, 10 cts. Guide, Mr. Clute.

THE Committee of Fifty has requested Professor C. F. Hodge, Clark University, to gather the testimony of physiologists upon two topics relating to the practical teaching of the physiology of alcohol, and he is asking the following questions: *First*, as to the facts at our disposal, will you please give a list of the points which you consider sufficiently well established and of essential importance to the education of medical and university students? We wish to learn your own view of the physiology value of alcohol as a food, condiment, stimulant and medicine; its influence upon the tissues, organs and upon physiological processes. Please give also a list of the important points that you think are not sufficiently well proved to form a part of our teaching material, the points about which there is too much present difference of opinion. *Second*, to what extent do you think it wise to introduce alchohol physiology into elementary public school courses? I refer to the 'Scientific Temperance Instruction' promoted by the W. C. T. U., viz.: the requirement by law that the subject be given considererable prominence throughout the school course. Have you examined any of the 'approved and endorsed' physiologies? If so, which ones? What is your opinion of them? Finally, will you give a list of the arguments which seem most conclusive to yourself either for or against this method of preventing alcoholism?

MR. JOSEPH COLLINSON, writing to the London *Times*, from Walsingham, Durham county, after referring to the reports showing that three golden eagles have been killed in Great Britain within the last six months, and two last year, says: "Our country is being rapidly deprived of some of the noblest of its feathered inhabit-

ants. During the last few years a number of species have become extinct, and other species are fast disappearing. Most of us, unfortunately, have never had the pleasure of seeing many of these birds, and I agree with Hudson as to the cause—the direct action of man, the greedy collector mainly, whose methods are as discreditable as his action is injurious. No one wishes to preserve birds which are really harmful, if such there be; but all birds which are merely curious and rare should be strictly preserved by the legislature. There must be a remedy for this state of things. In pointing out that the Wild Birds Protection Acts should be made general in terms, I beg to suggest that, if all birds cannot be protected, the right principle is to enumerate just those species which are to be outside the pale of protection, not those which are to be within it."

IN Argentina, Cyprus and many other countries the locust is a formidable crop pest. A successful series of experiments carried out in Natal, a report of which has been published in that colony as a government notice, and is abstracted in the London *Times*, will prove of interest in many parts of the world. All attempts to suppress the locust scourge in Natal have proved only partially successful, with the exception of the plan of poisoning with arsenic, which, it is asserted, has met with absolute and unqualified success. The mixture used is prepared by heating four gallons of water to boiling point and then adding 1 pound of caustic soda. As soon as this is dissolved, 1 pound of arsenic is added, after which the liquid is well stirred and boiled for a few minutes, care being taken that the fumes are not inhaled. Being poisonous the mixture is kept under lock and key, but when required for use half a gallon of it is added to four gallons of hot or cold water, with brown sugar or treacle. Maize stalks, grass, etc., dipped in the mixture are placed along the roads and in the fields, and the material can also be splashed with a whitewash brush upon anything which the locusts are known to have a liking for. Attracted by the odor of the sugar or treacle over a distance of as much as 100 yards, the locusts will eat of the mixture and die. Arsenic is quite effective in destroying flying locusts, but as they come and go very suddenly, it is difficult to have the poison in readiness at the critical moment, and hence the most deadly blow can be dealt at the pest when it is in the hopper stage.

A MESSAGE to all interested in promoting the education of the deaf in Europe has been sent from the officers and directors of the Columbia Institution for the Deaf and Dumb, at Washington, signed by William McKinley, Edward M. Gallaudet and others. In the opening paragraphs it is stated that the oldest school for the deaf in the United States was established in 1817, eighty years ago. In 1857 there were nineteen schools, the buildings and grounds of which had cost $1,371,736, the annual support of which involved an expenditure of $285,416, and in which 1,771 pupils were being educated. At the present time there are eighty-nine schools, with 11,054 pupils under instruction during 1896. Thirty-four of these schools are in private hands, or are day-schools connected with the common-school system of some city or town. No statistics are available as to the cost of buildings and current expenses of these. For the fifty-five public institutions more than $11,000,000 have been expended on buildings and grounds, and nearly $2,000,000 are appropriated, annually, for current expenses. In every State of the Union public provision is made for the education of the deaf, thirty-nine States having schools of their own, and the six States without them providing for the education of their deaf children in the schools of the neighboring States.

IT is safe to predict that the forests of Alaska will be of greater value to the world than its gold. *Garden and Forest* devotes the leading article of the last issue to the subject, saying: "Trees cannot be cut lawfully in Alaska for timber or fuel, for there is no law which permits the sale of stumpage or timber-lands, and no law relating in any way to the forests but the one which forbids all shipment of wood from the Territory. There are a few sawmills in Alaska, however, and the number will soon be increased, and a large quantity of firewood is consumed at the salmon canneries and quartz mines, but the government gets nothing for it, and is powerless to prevent damage to the

public domain. Fortunately, the climate of southeastern Alaska is so humid that forest fires are rare and never very destructive, and reproduction is sure and rapid. These forests, therefore, even with American methods, will not soon or easily be destroyed; and here and to the southward, along the coast ranges and islands of British Columbia, through nine degrees of latitude from Cross Sound, at the north of Chicago Island, to the Straits of Fuca, is now the greatest continuous body of coniverous timber in the world, almost unmarked as yet by the axe, safe from fire and of easy access, from which the world will be able to draw great stores of material when the Redwoods and Douglas Spruces of the South have fallen, and the south-Atlantic and Gulf-shore pineries are only dim memories."

UNIVERSITY AND EDUCATIONAL NEWS.

THE attendance at the American colleges and universities will be larger this year than ever before. The numbers given at present are subject to revision, but nearly all institutions report the largest entrance classes ever recorded. At Harvard the Freshman class will be over 500. At Yale the academic Freshmen number about 350 (a slight decrease as compared with last year), and the Freshmen in the scientific department about 175. At Pennsylvania nearly 200 Freshmen were registered, about 35 more than last year. The entrance class at Princeton will number over 300.

THE colleges for women—Bryn Mawr, Vassar, Wellesley, Smith and others—also report an increased attendance. It is noteworthy that there are in the United States 139 colleges and universities exclusively for men and 162 exclusively for women.

IT is now stated that the estate of the late Henry M. Pierce will yield $750,000 to each of the five legatees, which include Harvard University and Massachusetts Institute of Technology.

BY the will of the late Dr. Antoine Ruppaner the Harvard Medical School will receive $10,000, to be called the Dr. Ruppaner Fund.

MR. H. H. HUNNEWELL has given $5,000 towards the endowment of the Surgical Laboratory of the Harvard Medical School.

THE Rev. Dr. Eliphalet Nott Potter, formerly President of Union College and of Hobart College, has accepted the presidency of the Cosmopolitan 'University' (Correspondence School).

DR. HANS REUSCH, director of the geological survey of Norway, has been appointed for 1897–98 to the Sturgis-Hooper professorship of geology in Harvard University, left vacant since the death of Professor J. D. Whitney a year ago. Dr. Reusch will lecture on Vulcanism during the first half year, treating volcanoes and eruptive rocks in general; earthquakes and movements of the earth's crust. In the second half year he will lecture on the Geology of Northern Europe, and its relations to general geology. The third hour of each week will be set apart for seminary work. In the spring Professor Reusch proposes to take part in the instruction of advanced students in the field.

IN addition to a number of assistants, the following instructors have been appointed at the Massachusetts Institute of Technology: Carl H. Clark, S.B., in mechanical engineering; Frederick A. Hannah, S.B., in mechanical engineering; Charles M. Spofford, S.B., in civil engineering. The following promotions have also been made: Arthur A. Noyes, S.B., Ph.D., associate professor of organic chemistry; Frank A. Laws, S.B., assistant professor of electrical measurements; Harry M. Goodwin, S.B., Ph.D., assistant professor of physics.

DISCUSSION AND CORRESPONDENCE.

RESULTS FROM THE HIGHEST KITE FLIGHT.

TO THE EDITOR OF SCIENCE: Aided by a grant from the Hodgkins Fund of the Smithsonian Institution, the Blue Hill Observatory is endeavoring to obtain meteorological records in the free air at heights exceeding 10,000 feet, and on September 19th such records were obtained at the highest level which kites are known by the writer to have attained.

The flight in question was conducted without mishaps by my assistants, Messrs. Clayton, Fergusson and Sweetland. On the day mentioned, the sky was clear and the wind blew from the south in gusts of from 20 to 35 miles an hour. The Richard baro-thermo-hygrograph, which weighs three pounds and was suspended 130 feet below two large kites of Mr.

Hargrave's form but of Mr. Clayton's construction, left the top of Blue Hill at noon. Similar smaller kites were attached to the main wire at intervals, so that the 20,670 feet of wire unreeled, which weighed 59 pounds, were sustained in the air by seven kites, having a total lifting surface of 213 square feet. Angular measurements at the windlass of the meteorograph enabled its height to be determined at definite times. The greatest height was reached at 4:17 p. m., when the meteorograph was 9,255 feet above Blue Hill, or 9,885 feet above the neighboring ocean. The meteorograph remained more than a mile above the sea during five hours. The reeling-in by means of the steam windlass occupied about two hours, and at 6:40 p. m. the meteorograph returned to the ground.

The automatic records were found to be smooth and distinct, with the exception of a portion of the barometer and hygrometer traces which was lost, owing, perhaps, to the temporary drying of the ink in the pens. The altitudes given by the barograph agreed closely with those computed from the angular measurements, showing that the barometric heights were nearly correct for the mean temperature encountered. The thermograph showed the lowest temperature to have been 38° at 9,255 feet above the hill, whereas on the hill at the same time the temperature was 63°, giving a mean decrease of only 1° for each 370 feet of ascent. The relative humidity varied greatly with altitude, although on the Hill it remained near 50 per cent. of saturation during the first half of the flight, increasing to about 80 per cent. at the end. Up to approximately 3,000 feet above sea-level the relative humidity increased, proving the existence of an invisible vapor stratum near the level of the cumulus cloud level. Higher it suddenly decreased, but increased to over 80 per cent. at the height of a mile, indicating the level of the alto-cumulus clouds. Above 8,000 feet the humidity was very low and probably less than 30 per cent. of saturation. The wind veered to west as the kites rose and became steadier, although its velocity was probably greater than near the hill top, since the pull on the windlass, which was counteracted in part by the weight of the suspended wire, exceeded 150 pounds when all the kites were high in the air.

A. LAWRENCE ROTCH.

BLUE HILL METEOROLOGICAL OBSERVATORY,
September 27, 1897.

'THE PRESENT EVOLUTION OF MAN.'

THE discussion of my review of his work, which is given by Mr. Archdall Reid on pp. 368–372 of your issue of September 3d, deserves some sort of reply. Yet I write with some reluctance, because I can only make such comments as must already have suggested themselves to many readers, without attempting an adequate treatment of the matters in dispute, which would require a book.

As regards Mr. Reid's theory of retrogression, I certainly have to say that I think it is wrong. The general statement 'that the ontogeny recapitulates the phylogeny' was a brilliant generalization when first made, and within reasonable limits accorded with the facts. But surely it has since been made a fetish of, and the version of it accepted in some quarters reminds one of the not uncommon popular notion that all animals are descended from one another in a direct line! According to Mr. Reid's view, I do not quite see how a female can transmit male characters, or *vice versa*, as undoubtedly occurs. If, for example, the beard is a comparatively new character, a woman, having no beard, is so far atavistic. Yet that beardless woman will have bearded male offspring, independently of the hairiness of the the father. But if such illustrations are objected to as being different from those intended by Mr. Reid, we may take the case of a seasonally dimorphic butterfly, which alternately loses and gains a set of characters. Here we have a series ABABAB, etc. If A is the oldest phase, then B reverts to A, and the opposite process should not be possible. When we contemplate the primary and secondary sexual characters and all the phenomena of dimorphism and polymorphism, I do not see how we can avoid the conclusion that germinal selection is a reality. At all events, the writer, after carefully reconsidering the matter in the light of Mr. Reid's new statement, is more than ever convinced of the validity of his former argument.

Now, as to 'social efficiency,' I am equally unconvinced of error. Is it not clear that social conditions powerfully affect the selection of individuals, and therefore a society or nation depends for its existence largely on its corporate virtue? It is a commonplace of history that the success of nations has depended largely on their laws and customs, those advancing and spreading whose social conditions favored the existence of brave and noble men. To the evolutionist, the most discouraging feature of our present day civilization is the survival of knaves and fools, while good men and true so often go to the wall. If this process is not checked, the inevitable result is the breaking-up of society and a return to some form of savagery.

Mr. Reid's argument about alcohol appears to depend largely on his theory of retrogression —a theory which I do not accept. Of course, I do not deny that the general use of alcohol will lead to a process of evolution against it, but I do deny the desirability of any race undergoing such a process. The practices of the Spartans led to the survival of the strongest among their children, while weaklings perished; and while we should not now imitate them, they were justified in so far as the survivors were best fitted to defend the community in a time when physical defense was of prime importance and incapables were a serious hindrance. But the survivors of the pot-house are not particularly valuable individuals in other respects, nor is the ability to remain unaffected in the presence of whiskey a guarantee of good citizenship. Those very nations which are said by Mr. Reid to drink heavily are the leading nations of the world to-day. If Greece was anciently drunken and now is temperate, by all means give us drunken Greece!

There are three kinds of people, thus:

1. Those who have strong desires and keep them within bounds or divert them into suitable channels for social reasons.

2. Those who have strong desires but do not keep them within bounds or divert them into suitable channels.

3. Those who have not strong desires.

Mr. Reid's alcoholic evolution would apparently give us the third class. Savages largely belong to the second. I maintain that both the second and third classes are wholly undesirable, and that the first is the one to make a successful nation and to prove itself the fittest in the struggle for existence.* The second may become the first more easily than the third, and hence is more desirable. As missionaries will say, give us a man who strongly believes something, however demoniacal, and we can do something with him; but give us a man with no beliefs and we are almost helpless.

I fear Mr. Reid will feel strongly the inadequacy of my reply to his criticism, but he will forgive me in view of the difficulty of expressing oneself on such subjects in a few words. One's opinions are founded on the sum-total of one's knowledge and experience, and cannot always find justification in a few paragraphs.

T. D. A. COCKERELL.

MESILLA, NEW MEXICO,
September 9, 1897.

SCIENTIFIC LITERATURE.

Elementary Solid Geometry and Mensuration. HENRY DALLAS THOMPSON, D.Sc., Ph.D., Professor of Mathematics in Princeton University. New York, The Macmillan Company. 1897. 8vo. Pp. vii+199.

* The best nation would be one which contrived the fullest expressions of its desires with the minimum of harm. Some repression would be necessary because some of our desires or feelings were developed under different conditions. Thus the desire to kill an enemy may formerly have been advantageous, but could not be allowed full play under existing social conditions. I think we all at times would be more pugnacious if we permitted ourselves absolute freedom! At the same time, there is no doubt that under present circumstances excessive repression works a great injury, as I stated in my former article. One may compare the desires of the people to water flowing through a valley; if it is permitted to flow where it will it may be useless for agriculture and may even do much damage; if it is merely dammed up it is equally useless and is likely to break loose and do more harm than in the first instance; but if, by skillful engineering, it is directed into suitable channels it may all be made available for mills and irrigation, while dangers of flooding are avoided. Let those who are engineering the United States remember this and aim neither to waste nor repress the desires and energies of the people, but use them all for the good of all.

Professor Thompson's text-book on Elementary Solid Geometry will be received with pleasure by American teachers of elementary mathematics. It fills an almost unoccupied place by confining itself to a narrow field. Colleges that do not require solid geometry for entrance will find it especially useful.

There are six chapters devoted to those parts of the elementary solid geometry ordinarily taught in our colleges and secondary schools, one appropriate chapter on the conic sections and one on mensuration. Each chapter, excepting the fifth, includes a large and well selected set of exercises.

Of course plane geometry is assumed but the first seven pages are given up to a careful, though designedly not exhaustive, consideration of certain fundamental notions. It is well stated that postulates are propositions 'taken without proof and upon which a train of reasoning is to be built,' and 'that it is no part of geometry to justify their use except in so far as their form is concerned.'

The sequence of propositions is developed in a scholarly and logical though decidedly conservative manner. The assumed construction is rigorously excluded. Many of the demonstrations are informal or left entirely to the student. The treatment of mensuration, apart from the geometry proper, is a good feature.

Considering the completeness of the work as a whole, the proof on pages 122 and 123 is noticeable. The theorem is: "The arc of a great circle less than a semicircle is the shortest line on the surface of a sphere between two given points not diametrically opposite." This proposition can only be proved by the use of some such postulate as the following: "The magnitude of a curved line is the limit toward which a broken line made up of consecutive chords of that curved line approaches when the number of chords is increased in such a manner that the chords are all diminished without limit." (Thomas S. Fiske, SCIENCE, Vol. IV., p. 724.) The words 'curved line' and 'broken line' are to be understood to mean respectively 'a line no part of which is a great circle arc' and 'a line made up of great circle arcs.' It seems unfortunate that such a postulate was not explicitly stated.

The terminology used is, on the whole, that of the average text-book, but the author has rendered a genuine service to the American geometric vocabulary by the introduction of Mr. Hayward's term 'cuboid' in place of the clumsy expression 'rectangular parallelepipid.'

The pages have a different appearance from those of the majority of our text-books, for they are solidly printed in the English style and no abbreviations are used.

C. B. WILLIAMS.

Thirty Years of Teaching. L. C. MIALL. London and New York, The Macmillan Company. 1897. Pp. viii+250. $1.00.

There is at present in the educational systems of all countries a circle—to call it a vicious circle would be over-emphatic—discriminating in favor of the classical languages and against the sciences. Those having a classical education at college and university find positions in the schools and in turn prepare boys for the classical course at college. The circle tends to remain unbroken. Teachers of the classics, being a great majority of all teachers, are apt to write most of the educational books. But from the point of view of the man of science a new era has begun when students of biology, such as Huxley, Morgan and Miall, begin to write on educational topics. The circle is broken and adjustment will follow in accordance with the physical principle of gravitation or the biological principle of the survival of the fittest.

Professor Miall's papers, reprinted with some additions from the *Journal of Education* (London), cover a wide range of subjects. He does not hesitate to write on the teaching of history, of geometry and of Latin grammar, as well as on nature study and school musuems, but throughout he urges by precept and by example the methods of natural science, of nature. Treat the child as a child, speak plainly, be interesting—such maxims are sufficiently trite, but they carry weight and influence when put in a book that treats the teacher as a teacher, and addresses him in a plain and interesting manner. Professor Miall's book will repay reading by the teacher, whether of the classics or of science, whether in the kindergarten or in the university.

SCIENCE

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FRIDAY, OCTOBER 15, 1897.

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PROFESSOR FLINDERS PETRIE'S SCHEME OF AN ETHNOLOGICAL STORE-HOUSE.

OF late years many scientific men have realized that the function of museums has been imperfectly understood. Some museum officials still regard museums more in the light of cabinets of curiosities than as serious teaching institutions. There are two distinct ways of treating museums from the educational point of view; these may briefly be described as the method of the text-book or the plan of dictionary; a combination of the two is always difficult and often impossible.

To explain my meaning: The bulk of people go to a museum for intellectual amusement; they are interested in natural objects or in the works of man, and they visit the museum in a laudable spirit of curiosity and with a desire to receive instruction. What these people require is a comparatively small number of objects suggestively arranged, with descriptive labels and accompanied by carefully chosen drawings, photographs and maps. In a properly arranged museum of this type it should be impossible for any intelligent visitor to leave it without having gained definite instruction. This is what I venture to call the text-book museum.

The more serious student, he who is seeking to advance knowledge, requires a very different type of museum. It is necessary that he should have access to a large number

of specimens, and it is here that the recent way of studying natural history and anthropology makes itself felt. Formerly students were satisfied if they could see one or two specimens of any given species of plant or animal, or an example of a shield or a spear of a given tribe. Now they have learnt that it is necessary to have long series of representatives of a species or of the various implements and weapons of primitive races. The old order belonged to the period when the fixity of species was an article of faith. To-day the naturalist is more interested in varieties and intermediate forms. Formerly the naturalist delighted in clearly cut classifications; now he revels in tracing the infinite gradations of nature and in endeavoring to learn their significance. The same applies to the anthropologist; those, for example, who study the decorative art of savage peoples or of pre-historic times have to visit as many museums as possible in order to get a sufficiently long series to enable them to trace the origin and distribution of certain designs. No museum is likely to be too large for such students. This is what may be termed the dictionary type of museum, and the specimens contained within it require, like the words in a dictionary, to be so arranged that they can be referred to with the minimum amount of trouble.

Those who have seen the great stores of duplicates in such museums as the National Museum, of Washington, or the Agassiz Museum, at Harvard, will recognize that our American colleagues have realized this need; but there are many practical difficulties. In large towns space is too valuable to admit of the accumulation of long series, unless they are to be so stored as to be studied under great difficulties; and certain large objects, such as many anthropological specimens, would occupy so much space as to preclude their being collected. Further, the cost of the dust-proof cases which are absolutely necessary in cities is very great.

Appreciating the need for the collecting of long series of anthropological specimens; for the desirability of having representatives, or representations, of all the objects made by vanishing tribes of natives; and for the advisability of keeping together associated objects from extensive archæological excavations, Professor Flinders Petrie has devised a scheme which will give the greatest possible storage space for a given expenditure. This scheme, which he brought before the meeting of the British Association at Liverpool, is briefly as follows:

The conditions for a repository with such a scope are so wholly different from those of existing museums that the proportions of expenditure are entirely changed. The essential and primary condition is that space shall be of minimum value; and, as it is desirable to keep down wages and the cost of moving objects, it is needful that, whatever the amount of expansion, no rearrangement should be necessary.

The type of structure must, therefore, be a long gallery, with lateral expansions to be built as any section increases. The galleries must be sufficiently wide apart to allow of any likely increase, however irregularly distributed.

An economical type of gallery would be one about 54 feet wide, divided into a nave and two aisles, the latter being subdivided into bays, 16 feet long. From these bays lateral expansions would be added whenever necessary. The walls should be low —say 10 feet—and about one-fourth of the roof should be of glass, which would ensure the galleries being well lighted.

The essence of the scheme is that the site shall be ordinary agricultural or wooded land, so that, however irregular the expansion, the unoccupied land will continue to be productive. Thus every possible need of the future can be accommodated without

incurring more immediate expense than is now requisite, and without any loss of interest on capital not utilized. For this purpose it would not be unreasonable to secure about 500 acres. On this land galleries of 54 feet wide, built in blocks of 100 bays, or 1600 feet in length, should be placed at about a furlong apart. This would allow of each gallery expanding on either side for about 250 feet of out-building.

Each gallery should have in the middle of its length a policeman's cottage (fireproof) with its windows looking along the inside of the gallery.

The site should be within a short journey from London; fairly dry and sandy if possible, and belts of trees should occupy the spaces between the galleries and thus reduce the effect of wind and rain.

No glass cases would be required except for a few objects that needed to be kept dry. There would be little dust in a wooded country, and the absence of any internal heating and the filtration of all air passing in would diminish the chance of dust. Where glass was desirable, large loose sheets could be laid over boxes or shelves, and specimens could be put out of reach by having strips of wood screwed down to secure the glass.

In his memorandum on this 'Proposed Repository for preserving Anthropological or other Objects,' which was printed in the Report of the Association for 1896 (p. 935), Professor Petrie enters into further details and offers suggestions concerning the constitution of the trustees and the duties of the keeper, as well as the disposition and ownership of the specimens. He estimates that the total cost *per annum* would be $2,450 for a building equal to half the British Museum exhibiting area, and the securing of space for future building up to 50 or 100 times the present exhibiting area. This amounts to $1\frac{1}{2}$ per cent. on the present annual grant to the British Museum at Bloomsbury.

This scheme led to a lively discussion and various objections were raised against more or fewer of the details, the most serious being that Professor Petrie had greatly underestimated the prime cost and the annual expenditure. In his reply he faced all the objections and admitted that even if the cost was greater than he had allowed for, some such scheme as his would be vastly cheaper than any museum as at present constituted.

It is first necessary to take a broad view of the situation, and to decide whether it is desirable to greatly increase our anthropological and archæological collections. Anthropology is so recent a science that its full importance is realized only by a few, and there is a very real danger that by the time the general public is educated to recognize its value a very considerable amount of material will have disappeared. All scientific anthropologists agree in asserting that it is desirable to collect examples of all objects made by vanishing peoples, and to preserve them for future generations. The next question is, whether sufficiently extensive collections can be stored in existing museums, and whether the cost of warehousing them and of providing suitable cases is not likely to be somewhat excessive—so much so as to cause the curators to limit the acquisition of specimens. It is much to be feared that this is what would actually occur; but what is required is that the accommodation should be of such a nature that no desirable specimen should ever be refused.

If existing museums are unsuited for indefinite expansion new ones must be built. Professor Petrie has proposed a scheme which may well form the basis of a discussion until it is replaced by a better. The great point to remember is that the problem is fast reaching an acute phase and it must soon be faced.

A. C. Haddon.

Cambridge, England.

THE FUR-SEAL INVESTIGATION OF 1897.

THE result of this season's work has mainly been to emphasize those of previous years, and particularly of 1896, and to show the futility of the suggestion that it is possible to preserve the numbers of the seals so long as pelagic sealing is continued. Careful examination of the breeding grounds and a count of the young made in several places shows that there has been a decrease of not far from fifteen per cent. among the females and thirty per cent. among the killable males. This loss is practically in accordance with the conclusions reached by the American commissioners in 1896, when the total number of seals was computed at between 450,000 and 500,000. It is known that after the census of seals was made 35,000, not less than eighty per cent. of them females, were killed at sea and that certainly 16,000 pups starved in consequence of pelagic sealing in Bering Sea. If to this is added the loss from natural causes, which is believed to be high, it is easy to see that a decrease of fifteen per cent. would be well within the mark.

To one familiar with the seals the loss shows itself in many ways; the seals playing in front of the breeding grounds, once so numerous and still to a considerable extent present in 1896, have nearly disappeared; places filled by breeding seals last year were this season occupied by old males alone, who waited in vain for any females, and localities which were inaccessible to the investigator last summer could easily be reached this summer. The average number of females present in a harem was also found to be smaller this year than last, and wherever it was practicable to count the live pups there was in every case a falling-off from the figures of 1896. The greater proportional falling-off of the bachelors, or killable males, was expected, and is the result of the pelagic killing of 1892–94, during which time over 100,000 seals were taken on the nortwest coast and 31,000 in Bering Sea.

The evil results of the small quota of seals killed on the Pribilof Islands between 1892–95 are seen in the superabundance of full or nearly full-grown males, hundreds of these being turned away from almost every drive. So numerous have the males become that should it ever prove possible to bring about a cessation of pelagic sealing it will be necessary to kill several thousands of the old bulls, whose relatively great numbers led to continuous fighting throughout the past summer, with a consequent disturbance of the breeding grounds and loss of many females.

Up to August 20th none of the yearlings branded as pups last year had made their appearance, nor was it expected that many of them, possibly not any, would be seen this year. This is partly for the reason that the yearlings arrive late and also because all the seals branded were females and few of these come on shore until they make their appearance on the breeding grounds as two-year olds. As probably not more than thirty per cent. of seals born reach the age of two years, it will be seen that comparatively few of the 377 pups branded may be expected next year. Six of the eleven adult females branded as an experiment were, however, seen, a large number when it is remembered that not over half of the females are on shore at any one time, that the total number of females is over 100,000 and that they are scattered over eight miles of shore. In every case the brands were plainly visible, although the seals had shed their coats after the branding was performed, and there is every reason to believe that branding is a success. It is scarcely necessary to say that reports of branded seals being taken on the coast of Japan have no foundation, as are the mythical herds which have been driven from the Pribilofs to parts unknown.

While the practical results of the season's work have been to more firmly strengthen the contentions of the United States, the scientific results have been more than expected. The observations of Mr. Clark, while throwing much light on the problem of early starvation of young, have also done much to explain the manner in which harems are formed and the massing of seals in particular spots when there is plenty of room and often better ground close at hand.

The noticeable scarcity of three-year old females indicates the truth of the supposition that the death rate is high, this being the only class whose abundance or scarcity could well be noted, owing to the great similarity in the appearance of the older seals. On only one point did the results of this year's observations differ materially from those of last year, and this is in respect to the cause of death among young seals. The conclusion reached last year that the great majority of deaths among the pups was due to their being trampled on by the old seals is found to be erroneous and that the mortality is caused by a parasite, a species of *Uncinaria*, found in the small intestine. This course of danger was pointed out by Dr. Stiles as a result of the examination of a very few specimens obtained in 1896, and the matter will be discussed at length later. It may be said that young seals—and they alone seem to be affected—dying from an attack of *Uncinaria* perish so quickly that they lose little of their fat and that the disease is practically over before the end of August.

Finally, the past summer was unusually dry and clear, these conditions greatly facilitating the work of the party from the U. S. Coast Survey which is engaged in making a careful survey of the islands and especially of the breeding grounds.

F. A. L.

A BOTANICAL EXCURSION TO MEXICO.

Mexico is a profitable place for the botanist to visit on account of the richness of the flora, numerically speaking, and because of the assemblage in one geographical region of many species peculiar to a certain physical or meteorological zone. The aquatic flora, the Alpine flora, the desert and tropical floras, are all found associated within a radius of a few miles. Altitude and the distribution of the rainfall explain this somewhat interesting feature of the flora. The problems presented to the botanist for solution are very intricate, and it is necessary for him in order to solve the more difficult questions to spend considerable time in the field where the plants are to be found surrounded by natural conditions.

Each of the plant communities into which the flora of a country as vast as Mexico can be divided can be distinguished by the component plants which, together by their collective features, give character to the vegetation of a particular meteorological, geological or physical region of the earth's surface. Such a flora as the Mexican can be classified into several ecological* communities, as follows:

1. Hydrophytic Community, composed of Hydrophytes, or water-plants.

2. Xerophytic Community, composed of Xerophytes, or desert-plants.

3. Halophytic Community, composed of salt-loving plants.

4. Mesophytic Community, including those plants found in intermediate situations, such as plants of the tropical forests, palm forests, bamboo thickets, temperate deciduous forests, subtropical evergreen forests and plants of the Arctic, Alpine and prairie regions.

The valley of Mexico is especially suited

*Ecology is the study of plants with reference to their environmental conditions and covers the field of the so-called biology of plants.

to ecological inquiries. It is an elevated circular valley, closed in by two distinct ranges of hills, the oldest porphyritic rocks to the north and east, which before volcanic disturbances began sloped gradually southward toward the Isthmus, and the newer volcanic mountains to the south and west built up in a later period and closing off to the south and east the gradually sloping plain, thus forming the basin-shaped plateau known as the Valley of Mexico. Ajusco, the oldest volcanic peak, stands like a sentinel on the southern rim of the basin, and from its summit to the base of the valley extends a lava bed known locally as the Pedregal. On the southeast rim of the valley rises the ice-capped peak of Popocatapetl (17,780 feet), and to the eastward, connected with the conical volcano, the ridged backbone of Ixtaccihuatl, also snow-capped, considered by geologists to be built of the older porphyritic rocks. Along the base of the eastern range three fresh-water lakes, Texcoco, Chalco and Xochimilcho, are found, while the partially drained basin of lake Texcoco forms an alkaline plain stretching along the Mexican railroad to the hills which jut southward into the plain at Guadalupe.

The lakes and communicating ditches furnish the hydrophytes, the alpine summits of Popocatapetl, Iztaccihuatl and Ajusco (13,612 feet) the alpine plants; the lava beds afford a large number of xerophytes, while the alkali plain near lake Texcoco grows a number of halophytes which reach their greatest numerical development on the Gulf coast. The rich agricultural soil of the valley grows a varied and luxuriant series of mesophytes. It presents in its constricted area a veritable botanical garden, right at the doors of the population of the capital.

Space will not permit a detailed account of the plants found growing in the different vegetable zones. Only one or two plants can be taken by way of illustration. The xerophytes show very thick leaves, thick cuticle and a hairy or spiny covering, and are usually consolidated in structure. The plants are peculiarly constructed so as to store water by means of certain mucilaginous substances which absorb moisture and hold it tenaciously, giving it off very slowly to the air. The Agave, Maguey or Century-plant, commonly found cultivated on the plateau of Anahuac, is a typical xerophyte. It is to be seen growing wild in desert places and on lava beds, and grows in one or two forms to a large size (eight feet), weighing sometimes 600 to 800 pounds. It is a plant of considerable pharmaceutical interest. It stores up in its tissues a surprising amount of a sugary water, which exudes when the plant is tapped, as the so-called honey water or aguamiel. This aguamiel when fermented yields the beverage called pulqué, which is consumed in large quantities by the poorer Mexicans, who pay una cuartilla (3 cents Mexican, $1\frac{1}{2}$ cents American) for a glass of this yeasty-tasting alcoholic drink. It is obtained from the plant in the following way: When the Agave, which yields the liquid honey water, reaches adult size, turns slightly yellow and begins to shoot up a flower stock, or before that time, it is tapped by hollowing out a concavity in the core of the plant at the base of the central leaves, which stand upright and are not yet fully expanded. The pulqué-gatherer, with a long hollow gourd pierced at both ends, draws the aguamiel by suction from the concave place as it wells up from beneath. He is clad in cheap cotton clothes and wears a hide apron fastened around his waist and a thick leather knee pad on his left leg. Then pressing the spiny leaves aside with his left knee, he pushes one end of his gourd with his right hand into the tapped place and draws upon the other end with his mouth, until he has filled the

gourd with maguey liquid. He then transfers it to a vessel made of pottery reinforced by wicker work, or, as is the usual custom, he pours it into a vessel made of a hogskin. When his skin vessel is full he carries it to the shed, where for 36 hours the Agave juice is allowed to ferment, changing during this process from a yellowish-looking fluid to a milk-white, yeasty-looking fluid. It is a very refreshing and wholesome drink for those high altitudes, if taken in moderation. Drunkenness is the result of its too free use. It is laxative, and is reputed to be antiscorbutic, and through its assisting digestion quiets the heart's action. The best pulqué is obtained in country places, the writer finding its use refreshing and cooling, the city pulqué being inferior to that of the suburban towns, being watery and sour. Pulqué keeps its freshness but a day, when it begins to sour. The sour liquid is distilled and yields according to the process used two or three powerful alcohol drinks, mezcal, tequila and aguardiente de maguey. There are two or three beverages or soft drinks in use, one made from the pineapple and called piño, and another tepache might be termed sugar-cane cider. The latter drink, as a rule, is to be had along most of the country roads running from Mexico. The mezcal, tequila and aguardiente are very powerful in their effects. A Mexican Indian addicted to their use can drink a glass of any one of the three without effect; two or three glasses will set him demoniacally crazy.

The alpine flora is interesting on account of the dwarf, cespitose habit of the plants, their hairy covering and brilliantly colored flowers. The plants of this region are mostly perennial, very few annual plants being found in this zone. The lake flora is interesting, as the plants are distributed in the ditches and along the borders of the lagoons and lakes. *Eichornia crassipes*, the water hyacinth, *Marsilia heterophylla*, *Ruppia*, *Agenipea*, *Escobedea linearis*, *Polygonum amphibium*, *Nymphœa mexicana*, *Lobelia splendens*, and a water lily with white flowers and large leaves, are a few of the plants of the hydrophytic community.

The Chinampas, or floating gardens, are in lakes Chalco and Xochimilcho. At one time they really did float, but now they are anchored to the bottom by the roots of trees and form little patches of garden ground, separated by narrow canals. Here are grown flowers and vegetables for the city market The canoes of the Indians bring the produce to the city by the Viga Canal, where it is sold along the banks of the canal, or in the markets, the principal one of which is called the Volador, south of the National Palace and occupying a site that was included in the grounds of the 'new house' of Montezuma, and, therefore, after the Conquest was a part of the property of Cortez. Here are sold all manner of fruits and vegetables, apples, peaches, pears, pomegranates, mammees, figs, bananas, tunas, quinces, tomatoes, corn, beans and other agricultural products. The meat and poultry stalls are equally important, but it is to the sellers of herbs that a druggist would turn with most interest.

An old Indian woman, knitting or sewing, occupies a seat in an enclosed stall, surrounded on all sides by dried herbs and medicinal plants. For a small sum of money she will prescribe for all the ailments to which the flesh is heir, drawing upon her supplies of drugs hanging about the stall. These substances are compounded into medicine, according to her directions, and it seems that the peons have faith in her skill, for numbers of them were seen around the stall asking medical advice. Casually, while inspecting the market, hasty notes were made of a few of the remedies which composed her stock of drugs. There were panicles of *Sambucus mexicana*, dried flowers of *Datura arborea*, dried plants of

Achillea millefolia, a few Mammillarias, tops of *Datura* with stems and pods, dried gourds, bunches of unkown herbs wrapped in corn husk, bunches of the pepper tree (*Schinus*) *molle*, bunches of dried roots, sea beans (*Mucuna*), hoofs of a deer, ears of a donkey dried, stuffed birds, carapace of a turtle, dried alligator with skin removed, armadillo skins and other remedies too numerous to mention. I returned again and again to this market and always found it a source of information and amusement.

Mexico is a very rich and virgin field for ecological study and is yet an unworked field. Similar observations in other regions have been made by Dr. Eugene Warming, of the University of Copenhagen, several years ago in Venezuela; at Lagoa Santa, by Dr. Scott, who explored the Cape region of South Africa, in the Kalahari desert; by Professor Stahl in Java, and last year in Mexico; and by Professor Trelease, of the Missori Botanical Garden, on the Yuccas of the southwestern United States and northern Mexico.

JOHN W. HARSHBERGER.
UNIVERSITY OF PENNSYLVANIA.

BOTANY AT THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION G organized on Monday, August 9th, at 12 m., with about 18 persons in attendance, the Vice-President and Secretary both being in their places. After the election of 3 fellows to serve on the Sectional Committee further elections were postponed till the following morning, when the full organization was completed. The attendance on the meetings ran up each day to about 50, except during the Vice-Presidential address, when the room was crowded with about 150 people. The list of new officers elected for the Section is found elsewhere in this JOURNAL, and need not be repeated here.

Two invitations given to the Section were quite generally accepted by its members; the one being to a visit of inspection to the immense pharmaceutical laboratory of Parke, Davis & Co., in Detroit; the other being to a trolley ride and entertainment by Mr. Joseph Berry, of Grosse Pointe, where the fine grounds, extensive gardens and conservatories were greatly enjoyed.

During its session the Section was honored with a brief visit from Professor H. Marshall Ward, of Cambridge University, England.

The papers read numbered a total of 26. Several of the older botanists usually in attendance at the meetings of the Association were absent, and there was, therefore, a predominance of younger members; the quality of papers was, however, good, the most of them being narrative of original research on the part of their authors.

The preliminary program has already been published in SCIENCE (pp. 222–223 above), and the following papers were subsequently entered:

'On a New and Improved Self-Registering Balance,' by Dr. Alex. P. Anderson.

'The Correlation of Growth under the Influence of Injuries,' by Dr. C. O. Townsend.

'The Botanical Collection of the Cornell Arctic Expedition of 1896,' by Professor W. W. Rowlee and K. M. Wiegand. [Read by title.]

'Description of *Bacillus Phaseoli* n. sp., with some Remarks on Related Species,' by Dr. Erwin F. Smith.

'On the Nature of Certain Pigments produced by Fungi and Bacteria, with special reference to that produced by *Bacillus solanacearum*,' by Dr. Erwin F. Smith.

Since the address of the Vice-President on 'Experimental Morphology' has been published in full in this JOURNAL, comment need not be given here, except to say that the address, illustrated by lantern-slides was a collaboration of results of many botanists in experimental morphology, and was full of suggestion for future research in this direction.

Professor Davis' paper on the variation of

Trillium grandiflorum was accompanied by numerous dried specimens presenting the most remarkably monstrous forms. There were forms without the usual leaves, but in which all the floral organs except stamens were transformed into green foliage; acaulescent forms, forms with petioles 12 cm. to 15 cm. long, petiolated sepals and petals, forms with doubled sepals and petals, and forms without any stamens or pistils. In one locality in eastern Michigan over 400 monstrous individuals were collected. Of all organs the stamens vary least; they usually contain pollen. The pistils are commonly without true ovules, bearing leafy outgrowths instead. The author did not attempt to explain the teratology, but suggested that it might be propagated by fertilizing normal forms with pollen from the monstrous ones. In the discussion which followed the reading of the paper, Dr. Smith reported making a similar collection of the same species near the same locality and reporting it in the *Botanical Gazette* fifteen or more years ago. The Vice-President queried whether a preceding burning over with fire might not call forth the teratological forms. It was stated, however, by several present that such forms had been found where fire had not occurred for many years. Mr. Day reported a constant variety from Goat Island, Niagara River. Professor Britton had had no reports of these variations from the Appalachian region.

Mr. Wiegand reported variations in the form of fruit in closely related species of Galium. In some species the fruit is saucer-shaped, in others cup-shaped, and in others the edge of the cup is so narrowly constricted as to leave but a pore connecting the hollow interior with the exterior.

Professor Bessey reported the progress of the Botanical Survey of Nebraska. The Survey was organized in 1892 by the Botanical Seminar of the University of Nebraska, since which time it has brought together more than 10,000 specimens; published 'Reports I., II., III. and IV.'; published 'Parts I., II. and XXI.' of the 'Flora of Nebraska.' The total number of species known to the State is about 3,400.

This same author considered the question of the retreat of trees from Nebraska plains, concluding that none are known to be receding, while several species, such as the bur-oak and the pines, are advancing.

Dr. Bessey also described the foot-hill vegetation of western Nebraska. The foot-hill region is an elevated plain 1,200 meters above sea-level, upon which are Pine Ridge on the north, 1,500 meters above sea-level, and Cheyenne Ridge on the south, 1,700 meters above sea-level. Upon Cheyenne Ridge occur considerable bodies of trees, mostly pines, with red-cedar, box-elder and others. The Box Butte plains are covered with a uniform grass-formation.

Mr. J. H. Schuette's extensive paper on wild and cultivated roses of Wisconsin was read in brief abstract by Professor Bessey, who expressed himself as of the opinion that the author should make a wider study of native roses in the United States before publishing.

Professor Beal's paper, denominated 'How Plants Flee from their Enemies,' consisted in the citation of numerous examples of plant distribution as affected by hostile external conditions.

The 'Bacteriosis of Carnations,' as reported by Mr. Woods, is not due to a bacterial disease, as has been supposed, but to the punctures of aphides and thrips. The cells affected become œdemic, collapse and give a whitish sunken spot. The dead tissue may subsequently become infested by bacteria and fungi.

Dr. Erwin F. Smith reported the corroboration of Wakker's claim that a certain disease of the hyacinth is caused by a bac-

terium. The author was able to produce the disease by inoculation in healthy plants. Owing to the care with which the Hollanders inspect their exportations the disease is unknown in this country.

Dr. Smith described another bacterium, *Bacillus Phaseoli*, with related species, showing that this organism is a serious disease of garden and field beans. Thermal and cultural relations were shown, likewise drawings, photographs and macroscopical preparations, all aiding in the identification of the species.

The same author discussed the relations of the brown color of humus soils to the pigment produced by *Bacillus solanacearum*, suggesting that this coloration of soils may be due to the action of bacteria in splitting up the carbohydrates of the humus. The isolated pigment will not serve as nutrient material for bacteria.

Mr. C. A. Peters' report of the formation of the reproductive organs of *Drosera* showed some details of pollen-origin and structure differing from those in most dicotyledons.

Dr. Schlotterbeck reported that according to his study the appendage to the seed of *Melampyrum pratense* is not a strophiole, nor a caruncle, nor an arillus, each of which has been claimed, but is a part of the endosperm which becomes constricted off from the rest during development. The same author has found the nucellus of *Croton Tiglium* protruding far out of the micropyle, the only other similar case known being that of *Croton flavens*.

In the development of the pollen of the common milkweed, *Asclepias cornuti*, Professor Spalding reported the work of Miss Langdon as showing some errors in the published account by Corry, especially regarding the origin of the pollen-mother-cells and the outer wall of the pollinia. Peculiar changes in the protoplasm of the tapetal cells were also discussed with reference to their physiological significance. In the discussion which followed, the question arose as to what cells are to be denominated pollen-mother-cells in this plant—whether the cells that by division into four give rise to the pollen-grains, or whether these four daughter-cells themselves are the pollen-mother-cells.

Dr. Anderson reported the discovery o stomata on the bud-scales of *Abies pectinata*. What gives peculiar significance to this discovery is the fact that heretofore stomata have been thought never to occur on the bud-scales of Gymnosperms.

The paper by the same author on the comparative anatomy of normal and diseased organs of *Abies balsamea* showed differences in structures of leaves of the lateral and erect branches; the presence of 2 to 6 resin canals in the bud-scales from which the resin, exuding through fringing hairs, spreads in a layer 1 to 3 mm. thick over the scale; the formation of resin-vesicles in the primary cortex by the growth of the epithelial lining to the resin canals.

Dr. Townsend's paper on the correlation of growth and injury narrated experiments with seedlings, larger plants and with *Phycomyces nitens*. The injuries were given by excising parts of the plant, or by incisions. In *Phycomyces* there was a sudden retardation of growth after cutting, and the normal rate was regained after 30 to 60 minutes. In higher plants there ensues on severe injury a gradual retardation, followed by a gradual regain of normal rate, a period of acceleration sometimes preceding. In seedlings, especially, a rather slight injury caused an acceleration in 6 to 24 hours, with a subsequent fall to the normal rate. The distance through which the injury may influence the rate of growth may amount to several hundred millimeters. The amount of variation in rate of growth may equal 80 % of the normal rate.

'The Mechanism of Root Curvature'

is a vexed question. Professor Spalding reported work done in his laboratory from which it would appear that not only one side of the root is concerned in producing the bending, but both sides. As a result of numerous experiments it is concluded that the effect of the stimulus is not altogether, as has been supposed, on cell-membranes, nor upon the activity of protoplasm in manufacturing osmotic material, but is manifested in a molecular change in the protoplasm by which it becomes more permeable to water. The tense membranes consequently contract, shortening the side that thus becomes concave. It is claimed that, at the same time, the effect of the stimulus is to increase the length of cells on the side becoming convex. An important difference between this theory and its predecessors is that this proposes to utilize the tensions usually existing in straight roots to account for the curving.

The action of a cellulose dissolving enzyme extracted from cotyledons of seedlings of *Lupinus albus* was described by Professor Newcombe.

Professor True's paper on the toxic action of phenols on plants aroused considerable commendation and discussion. It has been known quite generally that plants are very sensitive toward certain substances, so sensitive that they may be used as tests for certain compounds diluted far beyond the capacity for identification by the usual chemical means. A study of the toxic action of the group of substances known as phenols has shown that living organisms respond in a definite manner to substances having a definite constitution, the reaction of the protoplasm being thus far governed by chemical laws. Electrolytic dissociation of the molecules into ions plays a subordinate rôle in the physiological action of these compounds, the undissociated molecules, therefore, determining to a large degree the physiological properties of the substances. Certain radicles seem to have specific properties when introduced into the molecule, modifying the toxic value of the same.

Dr. Hart sought to prove that the acridity of the juice of *Arum* is not due, as claimed, to the mechanical action of the raphides. He exhibited preparations of the extracted juice which had been filtered and still preserved its acridity. He described also a series of experiments upon himself, detailing the physiological effects of the administration of the juice.

Dr. Anderson described a self-registering torsion balance—an improvement over the one previously described by him. This instrument will record the increase or decrease in weight of any object that can be placed upon the balance, changes of .5 gm. being sufficient to make a record.

In joint session of Sections F and G, Professor Osborn and Professor Poulton presented a theory harmonizing to some extent Darwinism and Lamarckism, which is published in the present number (page 583) of SCIENCE.

FREDERICK C. NEWCOMBE,
Secretary Section G.

ANTHROPOLOGY AT THE TORONTO MEETING OF THE BRITISH ASSOCIATION.

SECTION H was perhaps the best attended of all sections of the Association, the large West Hall of the University of Toronto, where the sessions were held, being filled on several occasions, while on Wednesday, August 25th, when the joint discussion with Section C (Geology) took place, standing room was at a premium. The chairmanship of Sir William Turner, the celebrated anatomist, who presided with grace, dignity and a broad-minded discrimination that won the admiration of all who were privileged to present papers or to take part in the various discussions which arose, was a

delightful feature of the meeting, while the frequent attendance of Sir John Evans constantly reminded those present that the science of anthropology was well honored in the illustrious President of the Association. American anthropologists were well represented at the meeting and on the program as well—Miss Alice Fletcher, Professor F. W. Putnam, Dr. W J McGee, Professor E. S. Morse, F. H. Cushing, Dr. A. F. Chamberlain, Stansbury Hagar, Professor L. Witmer, etc., represented the United States, and David Boyle, A. F. Hunter, Rev. John Maclean, Geo. Iles, Dr. G. M. Dawson, etc., Canada. Among the distinguished British members present or contributing to the program were: E. W. Brabrook (President of the Anthropological Institute); Professor A. Macalister, of Cambridge; Dr. R. Munro, the investigator of British lake-dwellings; E. S. Hartland, the folk-lorist; Professor A. C. Haddon, who has written of 'Evolution in Art;' Dr. H. O. Forbes, traveler and anthropologist; F. T. Elworthy, who has written of the 'Evil Eye;' Sir Geo. S. Robertson, 'the hero of Chitral;' F. C. Selous, the South African traveler. Altogether some fifty reports, papers, etc., were laid before the Section and two extended discussions on 'American-Asiatic Contact' and 'The First Traces of Man in America' took place. Of the papers read, eight were by Canadians, eleven by British members, eleven by members from the United States.

The officers of the Section were as follows, due recognition being given to American anthropologists, both in Canada and the United States:

SECTION H.—ANTHROPOLOGY.

President: Professor Sir W. W. Turner, M. D., LL.D., F.R.S.

Vice-Presidents: E. W. Brabrook, C.B., Pres. Anthr. Inst.; Professor A. Macalister, M.D., F.R.S.; Dr. W J McGee; R. Munro, M.D., F.R.S.E.; Professor F. W. Putnam, D.Sc.

Secretaries: A. F. Chamberlain, Ph.D.; H. O. Forbes, LL.D.; Professor A. C. Haddon, D.Sc.; J. L. Myres, M.A., F.S.A. (*Recorder*).

Committee: F. H. Cushing; David Boyle; Dr. G. M. Dawson, C.M.G.; F. T. Elworthy; A. F. Hunter; Professor E. S. Morse; E. Sidney Hartland, F.S.A.; Professor Lightner Witmer, Ph.D.

Owing to the conservative regulations of the Association, Miss Alice Fletcher, being a woman, could not receive the official honor unanimously voted her by the Section Committee, who, however, by assigning her the first place on the program, paid a graceful compliment to her scientific attainments, which, together with the chairman's well-worded encomium at the conclusion of her address, was a tribute which an antiquated idea of scientific *personnel* utterly failed to minimize.

In detail the program was carried out as follows:

THURSDAY, AUGUST 18.

1. *The Scalp-Lock, A Study of Omaha Ritual.* MISS ALICE C. FLETCHER.
2. *The Import of the Totem Among the Omahas.* MISS ALICE C. FLETCHER.

In these two papers were contained remarkably clear presentations of the problems of what might, perhaps, be called 'the higher life' of the Omaha Indians, the general ideas and ideals which underlie the hair-cutting ceremonial and the institution of the totems being carefully explained and accidental or incidental phenoma rated at their true value. That the acquisition of the totem represented the outburst of individuality and personality on the part of the young Indian was ably shown, and the relations of personal, gentile and tribal totems elucidated.

The discussion following the paper was

shared in by Sir Wm. Turner, Dr. McGee, Mr. E. S. Hartland, F. C. Selous, all with warm appreciation of the ability of the author in her treatment of a very difficult subject. Dr. McGee emphasized the artificiality of certain social phenomena of primitive peoples. Mr. Hartland pointed out the great value of the proper interpretation of the ideas and institutions of the lower races.

3. *Squaktktquacht, or the Benign-Faced, the Oannes of the Ntlakapamuq, of British Columbia.* B. HILL-TOUT.

This was a detailed version of the 'younger brother' tale of the Ntlakapamuq, a Salish tribe of southern British Columbia. The 'Benign-faced' is culture-hero, animal-transformer, fish-befriended, wizard-destroyer, etc.

4. *The Blackfoot Legend of Scarface.* R. N. WILSON.

5. *Blackfoot Sun Offerings.* R. N. WILSON.

The first of these interesting papers told the adventures of 'Scarface,' a young Indian, whose personal disfigurement caused the maiden of his heart to refuse her hand in marriage until the scar on his face should be removed. After much wandering 'Scarface' accomplished this by the help of the sun (whose lodge he visited), the moon and the morning-star. Returning to earth, he received, in due time, his beloved, and instituted the system of offerings to the sun, of which a detailed account was given in the second paper.

6. *Star-Lore of the Micmacs of Nova Scotia.* STANSBURY HAGAR.

In this essay valuable details were given of the stellar Eden of the Micmacs, their lore of the Pleiades, moon and sun, the heaven-birds, etc.

7. *The Lake Village of Glastonbury and its Place Among the Lake Dwellings of Europe* (lantern illustrations). DR. R. MUNRO.

In this well-illustrated lecture the importance and the great extent of lacustrine remains in Europe were clearly demonstrated and the need for further explorations emphasized.

8. *Report on the Silchester Excavations.*

A brief account (a full report of the antiquities on exhibition at Burlington House is given in 'Archæologia,' Vol. LV., pp. 409–430) of the investigations carried on since 1896 on the site of the Roman city at Silchester.

9. *Some Old-World Harvest Customs* (lantern illustrations). F. T. ELWORTHY.

Illustrative account of the development and variations of the 'Kern-maiden,' and associated apparatus.

10. *Report on the North Dravidian and Kolarian Races of Central India.*

'No further progress' was reported in the transcribing and translating of Mr. Raynbird's extensive collections on the linguistic and anthropological characteristics of these peoples.

FRIDAY, AUGUST 20.

11. *Some Distinctive Characters of Human Structure* (lantern illustrations). The President's address, Sir W. W. TURNER.

The essence of this most admirable and eloquent address, to which a crowded hall listened with rapt attention, is contained in the following extract:

"We know that an animal is guided by its instincts, through which it provides for its individual wants, and fulfills its place in nature. In man, on the other hand, the instinctive acts are under the influence of the reason and intelligence, and it is possible that the association centers, with the intermediate association fibers which connect them with the sensory and motor centers, may be the mechanism through which man is enabled to control his animal instincts, so far as they are dependent on motion and sensation.

"The higher we ascend in the scale of humanity the more perfect does this control become, and the more do the instincts, emotions, passions and appetites become subordinated to the self-conscious principle which regulates our judgments and beliefs. It will, therefore, now be a matter for scientific inquiry to determine, as far as the anatomical condition will permit, the proportion which the association centers bear to the other centers, both in mammals and in man, the period of development of the association fibers, in comparison with that of the motor and sensory fibers in different animals, and, if possible, to obtain a comparison in these respects between the brains of savages and those of men of a high order of intelligence.

"The capability of erecting the trunk, the power of extending and fixing the knee joints when standing, the stability of the foot, the range and variety of movement of the joints of the upper limb, the balancing of the head on the summit of the spine, the mass and weight of the brain and the perfection of its internal mechanism, are distinctively human characters. They are the factors concerned in adapting the body of man, under the guidance of reason, intelligence, the sense of responsibility and power of self-control, for the discharge of varied and important duties in relation to himself, his Maker, his fellows, the animal world and the earth on which he lives."

The address was illustrated with numerous lantern-slides which served to render perfectly intelligible some of the more intricate anatomical points involved in the comparative study of the anthropoids, the human young and the various races of men.

12. *A Demonstration of the Utility of the Spinal Curves in Man.* PROFESSOR ANDERSON STUART.

By means of a most ingenious machine, in which were a straight brass rod and a curved one, made so as to be subject to concussion, Professor Anderson Stuart showed what would have been the result had the human spine been perfectly straight. The skull would have been broken.

13. *The Causes of Brachycephaly.* PROFESSOR A. MACALISTER.

14. *Notes on the Brains of Some Australian Natives.* PROFESSOR A. MACALISTER.

After noting the great prevalence (seemingly irrespective of race) of brachycephaly among infants, Professor Macalister emphasized the importance of brain-growth as a determining factor in head form; the increased bulk of the frontal lobes, which grow most rapidly and largest in the higher races, causes brachycephaly. Photographs of Australian brains were exhibited and explained to illustrate the points of difference between savage and civilized man.

15. *On Some Uses of Trepanning in Early American Skulls.* DR. W J MCGEE.

By means of an exhibit of pre-Incan Peruvian skulls, Dr. McGee discussed and explained the nature, process and probable uses of trepanning, the implements employed and the probable causes of the incisions. About 50% seemed cases of survival, but he did not care to credit the old Peruvians with very great surgical knowledge. Trepanning began in the taking of trophies; the head dwindled to a piece cut out of the skull, and passing through vicarious and sortilegic stages reached a stage of more or less blundering surgery.

In the discussion which followed the reading of the paper, Sir W. W. Turner seemed inclined to rank higher the surgical skill of the ancient Peruvians, and Professor Macalister stated that out of 87 Peruvian skulls he had examined two were trepanned, approximately the same number (2%) as Dr. McGee had found.

16. *Mental and Physical Deviations from the Normal Among Children in the Public Ele-*

mentary and Other Schools. Report (by DR. FRANCIS WARNER, Secretary of the Committee).

This fifth annual report of the committee 'gives an account of 1,120 children who appear to require special care and training, as being sub-normal in their mental or physical status.' The report is accompanied by many detailed tables. It is the intention of the committee to act in future with the recently formed 'Childhood Society,' of which the Earl of Egerton and Tatton is President and Sir Douglas Galton, Chairman.

17. *Report on Anthropometric Measurements in Schools.*

The work done by the committee during the past year has 'consisted solely in the distribution to applicants of the rules for measurement drawn up by the committee, and in advising those responsible for physical measurements in schools as to points respecting which they had written for advice.'

18. *The Growth of Toronto School Children.* DR. FRANZ BOAS.

This paper summarized the results of the extensive measurements of Toronto school children made in 1892, under the superintendence of Dr. A. F. Chamberlain. The chief points brought out were: American (Oakland, California) children are slightly taller than Canadian (Toronto); first-born children are somewhat taller than later-born children; families in Toronto are larger than those in Oakland; the families of Canadian descent are smaller than those in which the grandparents are of English birth.

In the discussion on this paper Professor Brabrook and Dr. A. F. Chamberlain took part, both emphasizing the importance of social atmosphere and environment in connection with physical well-being.

19. *An Experimental Analysis of Certain Correlations of Mental and Physical Reactions.* PROFESSOR LIGHTNER WITMER.

Professor Witmer, illustrating his remarks by numerous charts, discussed the differences in muscle tone, the rôle of the mental factor in physical processes, the sexual and racial differences in quickness of movement, etc.

In the discussion following the paper Professor A. C. Haddon, Dr. A. F. Chamberlain, Mr. David Boyle, all expressed their desire for a uniform system of mental and physical measurements, to be used in both the Old World and the New.

20. *Anthropological Work in the New York Pathological Institute.* DR. HRDLICKA.

In this paper Dr. Hrdlicka sketched the history, the prospects and the desirabilities of the anthropological department recently established in the New York Pathological Institute, as well as the system of investigation employed.

21. *The Physical Characteristics of European Colonists born in New Zealand.* DR. H. O. FORBES.

22. *A Case of Trepanning in New Mexico.* CARL LUMHOLTZ and DR. HRDLICKA. Read by title.

MONDAY, AUGUST 23.

23. *Report of the Committee on the Northwestern Tribes of Canada.* DR. FRANZ BOAS.

This was a summary of the work done under the auspices of the committee during the past twelve years in investigating the physical characters, languages and industrial and social conditions of the northwestern tribes of the Dominion of Canada.

In the discussion Professor Brabrook, Dr. A. F. Chamberlain, Professor E. C. Haddon and Rev. John Maclean took part, the evil of governmental interference with native tribes being pointed out.

24. *The Seri Indians of the Gulf of California.* DR. W J MCGEE.

A most interesting account was given of the Seri Indians, perhaps the most primitive of all American aborigines—autocthones, if there be any such in the New World; their arts and institutions, their fine physique, skill in hunting, their stone art, shell mounds, etc., were noted and described.

25. *Notes Historical and Philological on the Indians of British Columbia.* C. HILL-TOUT. Read by title.

26. *The Kootenays of British Columbia and their Salishan Neighbors.* DR. A. F. CHAMBERLAIN.

27. *Kootenay Indian Drawings.* DR. A. F. CHAMBERLAIN.

In the first paper the author discussed the relation of the Kootenays—whose language forms a distinct stock—to their Salishan neighbors on the west, the Shushwap. The Kootenay speech contains a few Salishan words; the animal tales of both peoples have many resemblances; the manufacturing arts are alike sometimes in detail. But the most remarkable contact-phenomena is the possession by both these peoples of the peculiar double (downwards) pointed canue, of what Professor Mason calls the Amoor type.

The second paper was devoted to the explanation of some 300 drawings—natural objects, men, animals, instruments, etc.—made by the Kootenay Indians, and the consideration of their resemblances to, and their differences from, the drawings of children. The keen observation gift of the Indian, the greater truth to nature, the longer time taken to draw them, all evidence the differences between these primitive art products and the cruder, ruder efforts of children.

In the discussion Sir William Turner and Professor Haddon called attention to the importance of such collections of primitive art, as also did Dr. Munro, who pointed out the necessity of such data for comparison with the art of early man in Europe.

28. *A Rock Inscription on Great Central Lake, Vancouver Island.* J. W. MACKAY.

Brief description, accompanied by photograph, of symbolic rock-carving of a tree.

29. *Blackfoot Womanhood.* REV. J. MACLEAN.

A detailed account of woman's life, arts, influence, etc., among the Blackfoot Indians of Canada. The Indian legends as to the creation of woman—she was made first—her sociological status, the influence of mythology and religion, the division of labor, marriage-customs, result of contact with civilized races, were touched upon. Some traces of 'woman's language' were found. The merry laughter of the women is noticeable.

30. *On the Hut-Burial of the American Aborigines.* E. SIDNEY HARTLAND.

An extended ethnographic account of burial within the hut as practiced by the American Indians. According to Mr. Hartland, 'Its origin must be sought for in the savage idea of kinship, and in the desire to retain within the kin the deceased, with all his powers and virtues.'

31. *Report on the Ethnological Survey of Canada.*

The first report of the committee appointed at the Liverpool meeting, 1896, suggesting subjects and lines of investigation of native and intrusive races of the Dominion.

32. *Origin of the French Canadians.* B. SULTE.

A brief account of the chief groups of early French settlers in Canada and their places of origin. Mr. Sulte notes a 'remarkable uniformity of language among the French Canadians'—a point regarding which there is still some dispute.

33. *Report on the Ethnographic Survey of the United Kingdom.*

The chief portion of the report was an extended folk-lore collection by the late Dr. Gregor.

In connection with the report Professor Macalister gave an interesting résumé of anthropometric data procured by him and Professor Haddon from the scientists on the Parisian, who kindly submitted to these measurements.

34. *The Evolution of the Cart and Irish Car* (lantern illustrations). PROFESSOR A. C. HADDON.

By means of excellent slides the author showed the various stages in the development of the body and the wheels of the cart and the Irish car, and demonstrated how its retention was a matter of adaptation to the soil rather than of extreme conservatism. In the discussion which followed, many members took part and the wide prevalence of solid wooden wheels and other primitive cart elements was made evident.

TUESDAY, AUGUST 24.

35. *The Jesup Expedition to the North Pacific Coast.* PROFESSOR F. W. PUTMAN.

The first part of the morning session had been set apart for the discussion of 'Evidences of American-Asiatic Contact' and the subject was introduced by Professor Putnam, who, after giving an account of the origin of the Jesup expedition now exploring the North Pacific Coast, under the auspices of the American Museum of Natural History, New York, gave at some length his reasons for believing in the contact under discussion. Professor Putnam refused to believe that the aborigines of America belonged to one and the same race, and was inclined to mark off the culture races of Mexico, Central and South America and the Mound Builders from the North American Indians. The Eskimo of East Greenland were perhaps métis with early paleolithic man; the Caribs suggested an Africo-Mediterranean origin. The art of Central America, too, was suggestive of Mongolian contact.

The discussion on the paper was begun by Professor E. S. Morse, who at some length discussed the evidence so far brought forward of culture influencing contact between the peoples of America and those of Asia, concluding that the very ancient civilization of China and the adjacent countries had never penetrated to the New World. From a comparative study of the two world-civilizations such contact appeared not to be proved. Mr. F. H. Cushing, from his investigations of the arts, games, etc., of the Zuñis was led to the same conclusion, that the American peoples unaffected by cultural influences from Asia had been working out their own destiny. Dr. A. F. Chamberlain expressed his belief in the unity of the American race and the absence of any clear proof of cultural contact.

36. *Why Progress is in Leaps.* GEO. ILES.

Taking the mastery of electricity and the invention of photography and all the improvements and useful discoveries which have followed in their train, Mr. Iles indicated the rôle these factors play in the increased acceleration of human progress, making a day with us more than a thousand years with our ancestors. Such things are multipliers of, not additions to, human genius.

37. *Note on the Transmission of Acquired Characters* (lantern illustrations). PROFESSOR J. C. EWART.

An account of the foal of an Arab mare, supposed to be infected by the zebra sire of her first foal.

38. *The Kafirs of Kafiristan* (lantern illustrations). SIR GEORGE ROBERTSON.

An interesting account of a people whose Greek physiognomy has been noted by more than one observer. Their bridge-building, wall-decorations, tombs, the sphere of woman, etc., were discussed.

39. *The Mangyans and Tagbanuas of the Philippine Islands* (lantern illustrations). PROFESSOR DEAN C. WORCESTER.

Professor Worcester described, with considerable detail, two very primitive tribes of the Philippines, the Mangyans, of Mindoro, and the Tagbanuas, of Palawan. Their physical characteristics, manners and customs, arts, etc., were treated of. Very interesting was the author's account of the childish temperament of the Mangyans and their actions when a mirror was given them; likewise their inability to recognize representations of themselves in a picture. The lowland people were less physically well developed than the mountaineers, and the result of contact with the Spaniards was bad for both. They have no belief in a future state. Concerning the Tagbanuas, the following points are noteworthy: Child-marriage, the precocity of children, belief in a subterranean heaven, love of music, use of a syllabic alphabet.

40. *Report on the Necessity of the Immediate Investigation of Anthropology of Oceanic Islands.*

Professor Haddon, in presenting the report, emphasized the necessity for investigation of rapidly disappearing flora and fauna and tribes of men who will soon be gone forever. This is much more important than the study of other phenomena whose number is practically unlimited, whose existence is practically perpetual. Every year is a year lost.

WEDNESDAY, AUGUST 25.

41. *The Trenton Gravels.* PROFESSOR F. W. PUTNAM.

42. *Human Relics in the Drift of Ohio.* PROFESSOR E. W. CLAYPOLE.

The first hours of the session were devoted to a joint discussion with Section C (Geology) on 'The First Traces of Man in the New World,' introduced by the two papers just mentioned.

Professor Putnam gave a résumé of the investigations in the Trenton Gravels and of the evidence which led him to believe in the existence of paleolithic man in northeastern America, laying great stress on the existence of argillite implements in the gravel.

Professor E. W. Claypole described the finding of a grooved stone axe in stiff clay near the bottom of a well during the digging of it. The find came from the great glacial plains of northern Ohio. The evidence, however, is not entirely convincing, as all who shared in the discussion took occasion to observe.

The discussion was begun by Sir John Evans, who declared that the Trenton implements were of a decidedly neolithic form, and declined to believe in the existence of paleolithic implements in America comparable to those of the river-drift of England and France. He rather favored a vast extension of its neolithic period in America.

Dr. J. W. Spencer gave his geological opinion as to the age of the Trenton gravels anywhere from 5,000 to 50,000 years.

David Boyle stated that there was no evidence as to the existence of man in Canada during or immediately after the glacial period.

Professor E. S. Morse was rather more favorable than the others to Professor Putnam's contention. Dr. W J McGee, while admitting the presumption that man was very ancient in America, advised conservatism in the matter of early man, and suggested that the argillite objects found in the Trenton talus may be quite modern, the product of the present Indian stock. Neither here nor in Ohio is the evidence convincing. A great mass of evidence to which constant and repeated appeal can be made by anyone at any time is the great necessity here.

43. *Exhibition of Lance-headed Implements of Glass from Northwest Australia.* Sir W. W. TURNER.

44. *The Genesis of Implement-Making.* F. CUSHING.

Starting with the arboreal, artless precurser of man in southeastern tropical Asia, Mr. Cushing traced his development and extension after the acquisition of a larger brain, of the power to use the hand, of speech, etc., emphasizing the rôle of the psychic factor—the rule of the ideal instead of the physical, and the influence of seashore residence on primitive man. The passage from teeth and nails to shells and the passage of man through the pre-lithic and proto-lithic periods was indicated with numerous illustrative experiments and references to the investigations of the shell-heaps of Florida and Maine. It was a great triumph for man when he ceased to be a mere user of tools and came to make tools with tools.

45. *Adze-Making in the Andaman Islands* (lantern illustrations). PROFESSOR A. C. HADDON.

Professor A. C. Haddon exhibited a series of slides from photographs taken by Mr. Portman, showing the natives of the Andaman Islands in the various stages of manufacturing their adzes. It was a model series of anthropological photographs.

In the number and nature of the papers read, the discussions which followed them and the interchange, after the sessions were over, of thought and suggestions, the session was one of the most successful in the history of the Association.

The grants for anthropological research made by the General Association were as follows, the committees marked * having been reappointed:

* Tylor, Professor E. B.—Northwestern Tribes of Canada	£ 75	0 s.
* Munro, Dr. R.—Lake Village at Glastonbury	37	10
* Brabrook, Mr. E. W.—Ethnographical Survey (and unexpended balance in hand)	25	0
* Evans. Mr. A. J.—Silchester Excavation	7	10
* Dawson, Dr. G. M.—Ethnological Survey of Canada	75	0
Turner, Sir W.—Anthropology and Natural History of Torres Strait	125	0

A. F. CHAMBERLAIN.

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*ORGANIC SELECTION.**

THIS discussion was held before a joint afternoon session of the Zoological and Botanical Sections. At the close of Professor Poulton's paper he was obliged to withdraw. The question of the inheritance of acquired characters was taken up by Professor Theodore Gill, and a few remarks were made by Professor C. E. Bessey and others upon the botanical side.

Professor Osborn introduced the subject by a brief history of the progress of thought in recent years, dwelling especially upon the fact that ten years ago all the leading Darwinians had strenuously adhered to the original view of Darwin, that 'fortuitous variation' plays the most important part in the origin of new types, and that there was little evidence for 'determinate variation.' He continued as follows: The evidence for definite or determinate variation has always been my chief difficulty with the natural selection theory, and my chief reason for giving a measure of support to the Lamarckian theory. This evidence has steadily accumulated in botanical and zoological as well as paleontological researches, until it has come to a degree of demonstration where it must be reckoned with.

Quite in another field, that of experimental embryology and zoology, the facts of adaptation to new and untoward circumstances of environment have begun to

* A discussion introduced by Professor Henry F. Osborn and Professor Edward B. Poulton at the Detroit meeting of the American Association, Wednesday, August 11th.

constitute a distinct and novel series of problems. In many cases they are so remarkable and so unexplainable that certain German writers, such as Driesch, have taken the ground that they spring from the ultimate constitution of living matter and are incapable of analysis. At the same time it has been recognized that these adaptations are purely individual, transitory or ontogenic, leaving for a long time, at least, no perceptible influence upon the hereditary constitution of the organism. What may be called the 'traditional' side of these adaptations impressed itself strongly upon Professor James Mark Baldwin in his studies of mental development, also upon Professor Lloyd Morgan in his studies of instinct. The latter, moreover, was one of the first among English selectionists to consider 'determinate variation' as a fixed problem which must be included in any evolution theory. Thus, independently, Professors Baldwin and Morgan and myself put together the facts of individual adaptation with those of determinate variation into an hypothesis which is in some degree new. The first illustration which I used was that of the creation of an 'arboreal man' out of any present terrestrial race by the assumption of an exclusively tree life. This life would be profound in its influences upon each generation producing what would be pronounced by zoologists a distinct specific type. In course of many thousand years such a type might become hereditary by the slow accumulation of arboreal adaptive and congenital variations. The basal idea of it was contained in the Romanes Lecture by Weismann, but it was not brought out with emphasis, nor subsequently developed by that distinguished author.

The position taken by Poulton, Morgan and Baldwin that individual adaptation is in itself a result of natural selection cannot be demonstrated, except in cases where it is evident that such adaptation is in response to revived ancestral experience. In many instances, individual adaptation, as in cases of regeneration, is of advantage to the individual, but decidedly detrimental to the race, where it would result in the perpetuation of the progeny of a maimed or imperfect embryo.

Organic selection is the term proposed by Professor Baldwin and adopted by Professor Morgan and myself for this process in nature which is believed to be one of the true causes of definite or determinate variation. The hypothesis is briefly as follows: That ontogenetic adaptation is of a very profound character. It enables animals and plants to survive very critical changes in their environment. Thus all the individuals of a race are similarly modified over such long periods of time that very gradually congenital or phylogenetic variations, which happen to coincide with the ontogenetic adaptive variations, are selected. Thus there would result an apparent but not real transmission of acquired characters.

This hypothesis, if it has no limitations, brings about a very unexpected harmony between the Lamarckian and Darwinian aspects of evolution, by mutual concessions upon the part of the essential positions of both theories. While it abandons the transmission of acquired characters, it places individual adaptation first, and fortuitous variations second, as Lamarckians have always contended, instead of placing survival conditions by fortuitous variations first and foremost, as selectionists have contended.

This hypothesis has been endorsed by Alfred Wallace. It appears to me, however, that it is subject to limitations and exceptions which go far to nullify its universal application. This is especially seen in the fact that the law of determinate variation is observed to operate with equal

force in certain structures, such as the teeth, which are not improved by individual use or exercise, as in structures which are so improved. A very large class of determinate variations in other stationary characters, such as the inner parts of the skull, also remain unexplained. My study of teeth in a great many phyla of Mammalia in past times have convinced me that there are fundamental predispositions to vary in certain directions; that the evolution of the teeth is marked out beforehand by hereditary influences which extend back hundreds of thousands of years. These predispositions are aroused under certain exciting causes and the progress of teeth development takes a certain form converting into actuality what has hitherto been potentiality.

Edward B. Poulton, M. A., F. R. S., Hope Professor of Zoology in the University of Oxford, continued the discussion. He began by saying that it must be admitted that the adaptation of the individual to its environment during its own life-time possesses all the significance attributed to it by Professor Osborn, Professor Baldwin and Professor Lloyd Morgan. These authorities justly claim that the power of the individual to play a certain part in the struggle for life may constantly give a definite trend and direction to evolution, and that, although the results of a purely individual response to external forces are not hereditary, yet indirectly they may result in the permanent addition of corresponding powers to the species, inasmuch as they may render possible the operation of natural selection in perpetuating and increasing those inherent hereditary variations which go further in the same direction than the powers which are confined to the individual.

Professor Osborn's metaphor in opening this discussion puts the matter quite clearly and will be at once accepted by all Darwinians. If the human species were led by fear of enemies or want of food to adopt an arboreal life all the powers of purely individual adaptation would be at once employed in this direction and would produce considerable individual effects. In fact, the adoption of such a mode of life would at first depend on the existence of such powers. In this way natural selection would be compelled to act along a certain path, and would be given time in which to produce hereditary changes in the direction of fitness for arboreal life. These changes would probably at first be chiefly functional, as Mr. Cunningham has argued (in the Preface to his Translation of Eimer). On these principles we can understand the arboreal kangaroo (Dondrolagus) found in certain islands of the Malay Archipelago, which is apparently but slightly altered from the terrestrial forms found in Australia. Professor Osborn has alluded to the arboreal habits said to have been lately acquired by Australian rabbits; these and the similar modifications in habits of West Indian rats are further examples of individual adaptive modification which may well become the starting point (in the sense implied above) of specific variation led by natural selection in the definite direction of more and more complete adjustment to the necessities of arboreal life. Although this conclusion seems to me to be clear and sound, and the principles involved seem to constitute a substantial gain in the attempt to understand the motive forces by which the great process of organic evolution has been brought about, I cannot admit that the importance of natural selection is in any way diminished. I do not believe that these important principles form any real compromise between the Lamarckian and Darwinian positions, in the sense of an equal surrender on either side and the adoption of an intermediate position. The surrender of the Lamarckian position seems to me complete,

while the considerations now advanced only confer added significance and strength to Darwinian standpoint.

I propose to devote the remainder of the time at my disposal in support of the conclusion that the power of individual adaptation possessed by the organism forms one of the highest achievements of natural selection, and cannot in any true sense be considered as its substitute. Professor Baldwin and Professor Lloyd Morgan thoroughly agree with this conclusion and have enforced it in their writings on organic selection. The contention here urged is that natural selection works upon the highest organisms in such a way that they have become modifiable, and that this power of purely individual adaptability in fact acts as the nurse by whose help the species, as the above-named authorities maintain, can live through times in which the needed inherent variations are not forthcoming, but in part acts also as a substitute, not indeed for natural selection, but for the ordinary operation by which the latter produces change. In this latter case natural selection acts so as to produce a plastic adaptable individual which can meet any of the various forces to which it is likely to be exposed by producing the appropriate modification, and this, it is claimed, is in many instances more valuable than the more perfect, but more rigid, adjustment of inherent variations to a fixed set of conditions.

A good example of the eminent advantages of adaptability in many directions over accurate adjustment in fewer directions is to be found in a comparison between the higher parts of the nervous system in insects and birds. The insect performs its various actions instinctively and perfectly from the first. It is almost incapable of education and of modifying its actions as the result of the observation of the effects of some new danger. It would appear that the introduction of the electric light can only affect the insects which are most attracted to it, by the gradual operation of natural selection. In the clothes-moths, which infest our houses, we may see an example of this; for these insects seem to be comparatively indifferent to light. Birds, on the other hand, have the power of learning from experience, of reasoning from the results of observation. At first terrified by railway trains, they learn that they are not dangerous, and cease to be alarmed; while the effect of fire-arms results in their increased wariness.

If this view of individual adaptability as due to natural selection be not accepted, it may be supposed that the individual modifications are due either to the direct action of the external forces or to the tendencies of the organism. But it is impossible to understand how the mechanical operation of such forces as pressure, friction, stress, etc., continued through a lifetime, could evoke useful responses, or why the response should just attain and then be arrested at a level of maximum efficiency. The other supposition, that organisms are so constituted that they *must* react under external stimuli by the production of new, useful characters, or the useful modification of old ones, seems to me to be essentially the same as the old 'innate tendency toward perfection' as the motive cause of evolution—a conception which is not much more satisfactory than special creation itself. The inadequacy of these views is clearly shown when we consider that the external forces which awake response in an organism generally belong to its inorganic (physical or chemical) environment, while the usefulness of the response has relation to its organic environment (enemies, prey, etc.). Thus one set of forces supply the stimuli which evoke a response to another and very different set of forces. We can, therefore

accept neither of the suggestions which have been offered. Useful individual modifications are not directly due to the external forces, and are not due to the inherent constitution of the organism.

The only remaining hypothesis is that which I have already mentioned—the view that whenever organisms react adaptively under external forces they do so because of special powers conferred on them by natural selection. This hypothesis will, it seems to me, meet and satisfactorily explain all the facts of the case, whether employed as a preparation or as a substitute for hereditary variations accumulated by natural selection.

ASTROPHYSICAL NOTES.

In the August number of the *Astrophysical Journal* Sir William and Lady Huggins publish a paper, read before the Royal Society in June, which throws light upon the perplexing behavior of the H and K lines of calcium in solar and stellar phenomena. It was early noted by Young that these lines were especially conspicuous in the spectrum of the solar chromosphere and prominences, while other calcium lines, strong in the ordinary solar spectrum, were seldom seen as bright lines. Recent researches with the aid of photography, chiefly by Hale, have still more emphasized the significant part played by these two radiations in chromosphere, prominences and faculæ. They rival those of hydrogen and helium in their prevalence and in the high elevations in the solar atmosphere in which they occur. It has therefore been the thought of many that possibly they are not due to calcium after all, but to some lighter gaseous element, existing as an undetected impurity in calcium, a view which after the discovery of argon in nitrogen would appear as not wholly unreasonable. Others have agreed with the opinion of Lockyer that at the excessive solar temperature the spectrum of calcium would become simplified so as to consist of but few lines, chiefly H and K, perhaps due to 'dissociation.'

The Huggins experiments now indicate, however, that the density is the determining factor, and they have succeeded in photographing in the laboratory a spectrum of calcium consisting solely of the H and K lines, with perhaps an analogous pair in the far ultra-violet region. This important result had hitherto not been accomplished by other investigators (although in retrospect, perhaps, it will appear that such plates have accidentally been secured), chiefly because the effort has been to use a spark of as high intensity as possible. The procedure now adopted consisted in taking the spectrum of a spark of feeble intensity passing between platinum electrodes which had been moistened with a solution of calcic chloride. Several *Ca* lines were present, but relatively to H and K the other lines were less intense than when electrodes of metallic calcium had been employed. On reducing the amount of calcium vapor present in the spark by successive washings of the electrodes in pure water the other lines retired, finally leaving only H and K.

These new results are confirmatory of the present view as to the extreme rareness of the vapors in the upper chromosphere, and may prove of much value in giving a criterion of the density of stellar atmospheres in the spectra of which the calcium lines appear in some of their different phases.

In connection with the approaching dedication of the Yerkes Observatory, which will occur on October 21st and 22d, a series of conferences will be held (from October 18th to 21st) which promise to be of much interest to astrophysicists. An extensive

program of papers and informal talks by numerous astronomers and physicists has been arranged, and experimental demonstrations are to be given of certain important recent discoveries, such as the effect of pressure upon wave-length, the application of interference methods to astronomical measurements, the effect of a magnetic field on radiation, etc.

Many celestial objects and the solar phenomena are also to be shown with the forty-inch Yerkes refractor.

E. B. F.

NOTES ON INORGANIC CHEMISTRY.

FROM an article in the *Eisenzeitung* on the output of platinum in Russia, we take the following notes: The Russian production of platinum is forty times greater than that of all other lands together. In Russia it is found exclusively in the southern Oural region. It is shipped in its crude state to Germany and there refined. (This statement is surprising, as it has been commonly supposed that most, at least, of the Russian platinum is worked up by Johnson, Matthey & Co., of London.) The output in 1895 was 4,413 kilos as against 2,946 kilos in 1880. The cost of crude platinum in Russia is at present about $216 per kilo. The amount of iridium found with the platinum is very small, being in 1895 only 4.1 kilos, in 1894 only slightly more than this.

IN the *American Journal of Science*, E. T. Allen describes several specimens of native iron from the coal measures of Missouri. They consisted of small grains, massed together in one instance in a calcareous sandstone, and in the others in a shale. Both sandstone and shale contained iron, and in two instances the grains were in close proximity to coal seams. The metallic iron in each case was quite pure and contained no nickel, and is considered to be undoubtedly of terrestrial origin.

IN the *Journal* of the Russian Physico-Chemical Society, G. P. Czernik gives an account of the investigation of the gases contained in two minerals from the Caucasus, a titaniferous cerite and a coal from Tkwibulsk containing in its ash 10 per cent. of the oxides of cerium, lanthanum and didymium. The former contains 1.1 per cent. of gases, chiefly argon, with a little oxygen and hydrogen. By heating to a red heat only one-fourth of the argon was liberated, by the action of 25 per cent. sulphuric acid at 60° rathar more than one-half. Much more was given off by fusion with potassium bisulphate. The author from this concludes that the argon is in chemical combination. The second mineral contains helium, which is liberated by fusion with potassium bisulphate, even after the ash has been heated to a white heat. Here, too, the inference is that the helium is in chemical combination.

THE *Bulletin* of the Pharmaceutical Society of Bordeaux, for July, contains an article by Dion on the formation of the fossil phosphate deposits of the Province of Oran. He concludes that they have an aqueous origin, being formed from above downwards by the action of infiltrating rain-water, and that animal remains were the only source of phosphorus in the deposits.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE SPELLING OF GEOGRAPHIC NAMES.

AT the regular monthly meeting of the U. S. Board on Geographic Names, held a few days ago, decisions were made as to the spelling of 149 geographic names. This Board, it will be remembered, is composed of ten members, representing those bureaus and departments of the government which are more or less concerned with geographic publications. It was created by executive order September 4, 1890, to the end that uniform usage in regard to geographic nomenclature and orthography shall obtain

throughout the executive departments of the government and particularly upon its maps and charts.

Among the decisions rendered were a few of general interest. These relate to names brought into prominent notice through the Klondike gold excitement.

As to *Klondike*, the decision is to spell it as here given, and *not* Clondyke, Klondyke, Chandike, Chandik or Deer, Reindeer, Trondike, nor Thron Diuck.

One of the lakes of the upper Yukon was named *Lebarge* by the Western Union Telegraph Expedition in 1868, after Mike Lebarge, a member of the exploring party, and a popular member, it may be added, who is now living somewhere near Ottawa, Canada. Late publications have fallen into the error of writing this Labarge, but the Board adheres to the original form, Lebarge. There is a Lebarge River in Alaska.

When Schwatka discovered the Yukon, in 1883, he named one of the lakes on its headwaters *Lindeman*, after Dr. Moritz Lindeman, now Vice-President of the Bremen Geographical Society. This sometimes appears, erroneously, as Lindemann and Linderman. The Board adopts Lindeman.

One of the principal tributaries of the upper Yukon is the *Lewes* river, named by Mr. Robert Campbell, of the Hudson Bay Company, about 1848. This is often miscalled Lewis.

The inlet, river and village at the head of Lynn canal, which now appears in the newspapers, almost daily, under the form Dyea, is an Indian word, which has appeared in many forms. Admiral Meade, in 1869, wrote it Tyÿa; Krause, in 1882; wrote it Dejäh; Schwatka, in 1883, Dayay; Dall, in 1883, Taiya. The Board adopts the form *Taiya*.

For the lake and river variously called Hootalinqua, Hotalinga, Teslin-hina, Teslin-too or Teslin the Board adopts *Teslin*. The terminations 'hina' and 'too' are said to mean river in different Indian dialects.

An Indian village on the middle Yukon is called *Nuklukayet*. This has been written in several forms, including the erroneous one, Tuklukyet.

W. F. MORSELL.

THE 'KAISER WILHELM DER GROSSE.'

THE North German Lloyd steamer 'Kaiser Wilhelm der Grosse' arrived at the port of New York on the 26th of September, her maiden voyage proving extraordinarily satisfactory. This ship is in many respects very remarkable. She is the largest ship afloat and nearly as large as the now non-existent 'Great Eastern;' the speed on her voyage, for a single day's run, exceeded that of any ship ever set afloat, not excepting the Cunarders 'Campagnia' and the 'Lucania;' the record for the run between Southampton and New York was broken, and the speed of the ship was such that had the voyage been between Liverpool and New York the run would have been considerably shorter than that of any steamer on that route. Not the least remarkable fact is that this new record was made on her maiden voyage.

The ship has the following dimensions; beside which are here given those of the 'Great Eastern,' the marine wonder of forty years ago:

	K. W.	G. E.
Length over all	649	697
Length between perpendiculars	625	680
Beam	66	83
Draught	26	30
Depth	43	58
Gross tonnage	14,000	19,500
Displacement	20,000	27,000
Horse-power	30,000	12,000
Speed, knots	23	12

The 'City of Rome,' of the last decade, is 561 feet long; the 'Campagnia' and the 'Lucania,' now two years old, are 625 feet long; and the length of the 'Oceanic,' of the White Star Line, now under construction, is 704 feet. The 'Kaiser' is very steady, having been fitted with bilge-keels to prevent rolling in a seaway.

The driving engines of the 'Kaiser' are 'triple-expansion,' one engine on each of her twin-screw shafts, with steam-cylinders 52, 89¾ and 96½ inches (two of the latter to each engine) diameter, and drive two three-bladed screws, 22 feet 3¾ inches diameter, 32 feet and 10 inches pitch, with a maximum of 30,000 horse-power, at the rate of twenty-three knots through the water (twenty-six miles an hour).

The propeller shafts weigh 166 tons, the bronze screws 26 tons each. The condensers contain 35,522 square feet of cooling surface, their 11,000 tubes measuring a total length of about thirty-five miles. There are, altogether, 68 engines on the ship, with 124 steam-cylinders. The centrifugal pumps and the engine bilge-pumps can, together, expel 3,600 tons an hour. Four dynamos are employed for lighting purposes, supplying current to 1,600 25-candle-power lamps. The cost of this floating palace was $3,500,000.

The hull is very graceful and most imposing, with its lofty sides and extreme length, its four smoke-stacks and its several stories of deck-houses. It is enormously strong and is divided by 16 transverse bulkheads and one running longitudinally. The 14 boilers are in four groups, each in a separate compartment, and the two main engines are similarly isolated. A double bottom gives additional safety. Accommodations are provided for 350 first-cabin, and as many second-cabin and 800 steerage passengers, and for a crew of 450 men, including 17 engineers, 18 boilers, 90 stokers and 75 coal-passers. Room is found for bunkers capable of containing 4,950 tons of coal.

With steam at 180 pounds pressure this ship developed 28,430 horse-power and made a run of 564 knots in a single day—the highest record yet known. The run from Southampton to New York was made in 5 days, 22 hours, 35 minutes (3,050 nautical miles); averaging 22¾ knots for the fastest 24 hours, 21.39 for the voyage. About 500 tons of coal a day were burned on the trip. The record from Liverpool to New York, now held by the 'Lucania,' is 5 days, 7 hours and 23 minutes; but the 'Kaiser' could make the run in about 5 days—possibly in 4 days, 22 hours.

R. H. T.

THE AMERICAN JOURNAL OF PHYSIOLOGY.

THE number of investigations in physiology and its allied sciences now made in this country has grown so large that the present means of publication are no longer sufficient. Physiologists can no longer print in foreign countries, often in foreign languages, or in general medical journals, without stunting a growth which, unchecked, will come to be a gratification to every American and a wholesome influence in American medicine. To meet the needs of investigators in physiology, physiological chemistry, physiological pharmacology, bio-chemistry and certain other branches of biology, a special journal will be published, the first number appearing in January, 1898. *The American Journal of Physiology*, as the new publication will be called, will contain in each volume about five hundred pages, divided into parts or numbers, to be issued whenever material is received. It is expected that not more than one volume a year will be printed. The *Journal* will be edited by H. P. Bowditch, M.D., Boston; R. H. Chittenden, M.D., New Haven; W. H. Howell, M.D., Baltimore; F. S. Lee, M.D., New York; Jacques Loeb, M.D., Chicago; W. P. Lombard, M.D., Ann Arbor, and W. T. Porter, M.D., Boston.

It is not to be supposed that a journal devoted solely to the publication of original researches in physiology will ever do more than pay for its paper and printing, and it is probable that some years must pass before the new enterprise will cease to be a financial burden on a small number of investigators. Yet the need of such a publication is undoubted. The aid of all friends of learning is asked until the *Journal* shall be established on a self-supporting basis. The subscription price, which is five dollars per volume, should be sent to W. T. Porter, M.D., 688 Boylston Street, Boston, Mass.

GENERAL.

THE American Chemical Society will hold its annual winter meeting at Washington on December 29th and 30th.

AT the recent Brunswick meeting of the German Society of Men of Science and Physicians a resolution introduced by Professors Virchow, Waldeyer and Neumayer was adopted, asking the Emperor for a grant (from the Royal fund for various purposes) for a deep-sea expedition to the Indian Ocean.

THE Southern Mahratta Railway will give free passes to observers of the total eclipse of the sun on January 22, 1898.

DR. MITSUKURI, professor of zoology at the

Imperial University of Tokyo, and Shirofujita, Director of the Commercial Bureau of the Department of Agriculture, have been appointed commissioners from Japan to attend the conference on the seal fisheries to be held shortly at Washington. M. Pierre Botkin has been appointed commissioner from Russia. If the commission is composed of men of science of high rank the results of the conference will carry much weight, even though Great Britain and Canada decline to send representatives.

PROFESSORS J. J. STEVENSON, J. F. KEMP and R. E. DODGE gave an informal reception to Professor Albrecht Penck, of Austria, at the Teachers' College, New York City, on October 7th. Owing to the short time allowed for arrangements, but a small party were present, composed largely of the geologists and geographers of the vicinity of New York. The Committee were also very fortunate in being able to greet Sir John Evans, who was in the city for but a few days. The New York Academy of Sciences had planned to give a reception to Sir John Evans and Lord Kelvin, but a time could not be arranged.

DR. FRIDTJOF NANSEN will read a paper on some of the scientific aspects of his recent Arctic exploration before the American Philosophical Society on Friday afternoon, October 29th.

DR. NEWTON C. BATES has been appointed Surgeon-General and Chief of the Bureau of Medicine and Surgery of the Navy, to succeed Surgeon-General Tryon.

PROFESSOR VLADIMIR I. BELAJEFF, professor of botany in the University of Warsaw, has been appointed Director of the Botanical Garden in that city, and Professor Vladimir I. Palladin, of Kharkoff, has been made Director of the Pomological Garden at Warsaw.

THE College of Physicians of Philadelphia has awarded its Alvarenga prize for 1897 to Dr. Joseph Collins, of New York, for a paper on 'Aphasia.'

WE learn from *Natural Science* that the first Flükiger medal—an honor to be awarded every five years by the German and Swiss Pharmaceutical Societies alternately—has been presented to Mr. Edward Morrell Holmes, Curator of the Museum of the Pharmaceutical Society of Great Britain. An account of Mr. Holmes' work in botany, illustrated by a portrait, appears in the *Pharmaceutical Journal* for September 4th.

THE Zoological Society, London, has conferred its silver medal on Mr. Alexander White, for his studies on the fauna of Nyassaland.

MR. G. H. DARWIN, professor of astronomy at Cambridge, now on his way to America to give a course of ten lectures on 'Tides' at the Lowell Institute, has been elected a foreign member of the Academia dei Lincei, Rome.

MESSRS. ROBERT G. AITKEN and W. H. WRIGHT have been appointed assistant astronomers at the Lick Observatory.

PROFESSOR F. W. CLARKE, Chief Chemist of the Geological Survey, has been appointed, by the Secretary of the Interior, Representative of the Department of the Interior and its several bureaus at the Omaha Exposition. Professor Clarke, who now represents the Department at the Nashville Exposition, has held a similar position in connection with every previous exposition in which the general government has taken part in recent years.

DR. WESLEY MILLS, professor of physiology in McGill University, has been given leave of absence for a year, which he will spend abroad. Correspondence, however, addressed to McGill University will be forwarded to him.

A STATUE of Balboa, the discoverer of the Pacific Ocean, will be erected in Golden Gate Park, San Francisco. It will be executed by Mr. Douglas Tilden, and is the gift of Mayor Phelan.

WE regret to record the deaths of Professor Charles T. Roy, since 1884 professor of pathology in Cambridge University, aged forty-seven years; of Mr. W. A. Stiles, Park Commissioner of New York City and editor of *Garden and Forest*, in Jersey City on October 6th, at the age of sixty years; of Dr. Herman Welcker, formerly professor of anatomy at the University at Halle, at Winterstein at the age of seventy-five years, and of Dr. Konrad Bohn, professor of mathematics and physics at the Forestry Institute at Aschaffenburg.

A DISPATCH from Melbourne states that the expedition of the Sydney Geographical Society, under Professor David, to the Ellice Islands, between the Gilbert Islands and the Fiji Islands, has obtained evidence confirming the theory of Darwin as to the formation of coral islands. Diamond drilling in coral to the depth of 557 feet failed to reach bottom.

A SOCIETY entitled 'Société des Sylviculteurs de France et des Colonies' is being formed in France, as has been learned from *Garden and Forest*, for the purpose of diffusing the knowledge of silviculture and increasing popular interest in this art.

DURING the year ending June 15, 1897, there have been added to the library of the University of Chicago 10,717 books, of which 7,383 were purchased, 2,930 were added by gift and 404 in exchange for University publications.

THE preliminary plans of the New York Zoological Park, to be located in South Bronx Park, New York, have been completed and will be submitted first to the President and the Executive Committee, then to a committee of three experts, consisting of Professor Charles S. Sargent, director of the Arnold Arboretum; Thomas Hastings, architect, and W. Barclay Parsons, civil engineer. If their reports are favorable the plans will then be submitted without delay to the Board of Park Commissioners. With the final plan of the Zoological Park grounds will be submitted the plans and elevations for the following buildings: The lion house, the monkey house, the elephant house, bird house, winter house for birds, reptile house, tropical ruminants' house, main restaurant and administration building. Of secondary structures will be submitted the plans for the flying cage, eagles' and vultures' aviary, wolf and fox dens, bear dens, sea lions' pool, pheasants' aviary, buffalo house, deer barns, mountain sheep shelter and ducks' aviaries. If the society's plans are approved by the experts and the Park Commissioners, the engineers will prepare plans for a system of sewerage and water supply.

THE London correspondent of the New York *Evening Post* telegraphs that at Maidstone vaccination is being used against typhoid under the direction of the pathological laboratory of the State Army School at Netley. Professor Wright and Surgeon-Major Temple, of Netley, have so improved the method that they are able to obtain the characteristic reaction of blood serum on typhoid bacilli, which is taken as a proof that the individual is protected by the injection. Enough vaccine has been sent to Maidstone to inoculate the whole population if necessary. The number of cases of typhoid fever reported is greater than 1,500.

ADVICES from Honolulu state that the lava in the crater of Kilauea has risen over 100 feet in eight days and that an overflow is expected.

THE report of the trustees of the South African Museum, Cape Town, for 1896, says *Natural Science*, records the reorganization of the staff and the completion of the new buildings. The Museum now has the services of Mr. W. L. Sclater as Director; Mr. L. Peringuey as Assistant Director, with special charge of the insects; Dr. W. F. Purcell as keeper of land invertebrates; Dr. G. S. Corstorphine as keeper of geology and mineralogy, and Dr. J. D. F. Gilchrist as honorary keeper of marine invertebrates. During the year 1896 a special grant was expended upon the purchase of a series of large mammals for the collection, while an exchange with the La Plata Museum furnished an important series of South American mammals and birds. Large acquisitions of European rocks and fossils were also purchased for comparison with the South African specimens.

THE Honorable William T. Harris, United States Commissioner of Education, will deliver five lectures on 'The Philosophy of Education' at the Teachers' College, New York, on the following dates: Thursdays, October 14th and 28th and November 4th, at 3:30 p. m.; Fridays, October 15th, at 2 p. m., and October 29th, at 3 p. m.

A COURSE of twelve lectures on the 'The Geological History of Invertebrate Animals' is being delivered by R. H. Traquair, M.D., F.R.S., in the Lecture Theatre of the South Kensington Museum. These are the Swiney Lectures on Geology, given under the direction of the trustees of the British Museum.

THE American Forestry Association has held a special meeting at Nashville, Tenn., with an excursion to Biltmore and Chattanooga, leaving Washington for Biltmore on the night of of September 16th. The party were entertained at Biltmore by Dr. Schenck, who explained and illustrated the methods of forestry management used on the estate of 1,300 acres. The chief meeting was held at Nashville on September 22d, at which papers were presented by Messrs. George B. Sudworth, J. B. Killegrew and others.

THE Macmillan Company will have ready for publication in the autumn the first volume of 'The Scientific Papers of Henry T. Huxley,' reprinted from the journals of scientific societies, edited by Professor Michael Foster and Professor E. Ray Lankester. The scientific papers are expected to fill four volumes.

THE current number of *Nature* (September 30) publishes the address on 'Long Range Temperature and Pressure Variables in Physics' given by Professor Barus as Vice-President, before the Section of Physics at the Detroit meeting of the American Association.

PROFESSOR J. J. THOMPSON'S work on the 'Elements of the Mathematical Theory of Electricity and Magnetism' has been translated into German by Professor Gustav Wertheim, being published by Friedrich Vieweg, Brunswick.

UNIVERSITY AND EDUCATIONAL NEWS.

AT a meeting of the trustees of Columbia University, on October 4th, President Low presented the following letter:

COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK.
PRESIDENT'S ROOM.

October 4, 1897.

To the Trustees: As I have felt constrained by a sense of public duty to accept a nomination for Mayor of the City of New York at the hands of the Citizens' Union, I feel it to be my duty to the University to place in your hands for such action as you may see fit to take my resignation as President of the University.

I need not say that nothing but a deep sense of the imperative nature of the call to public duty would have led me to accept the nomination.

Respectfully,
SETH LOW.

The letter of resignation was referred to a committee, which cannot report until the next meeting of the trustees, on November 15th, when the election will have taken place.

THE 22d of October will hereafter be celebrated at Princeton University as Charter Day. Ex-President Cleveland will this year make the address. A short address is also expected from the Earl of Aberdeen, Governor-General of Canada, on whom a degree will be conferred.

PRESIDENT HARPER, of the University of Chicago, reports in his quarterly statement that there were in the University 169 instructors, of whom 19 are head professors, 22 professors, 27 associate professors and 21 assistant professors. The average salary for the year 1896-7 for all departments, including University Extension Division and the Divinity School, was $2,108.52.

THE Union of the Medical Departments of New York University and of Bellevue Hospital Medical College having failed, the building of the latter institution, which was destroyed by fire, has been rebuilt, and the College was opened on September 28th. Professor Lusk, whose death we were recently compelled to record, has been succeeded as president by Dr. Edward B. Janeway and as clinical professor of gynæcology by Dr. Henry C. Coe. Dr. Henry H. Rusby has been appointed professor of materia medica and pharmacology, and Dr. John A. Mandel, professor of chemistry.

ACCORDING to a letter to the Boston *Transcript* the serious damage suffered by Johns Hopkins University through the lapsing of dividends on Baltimore & Ohio stock has aroused the Baltimore Board of Trade to consider the question of extending aid to the institution from the public treasury. The Board will probably memorialize the State Legislature at its approaching session, setting forth the great advantage to Baltimore in a hundred different ways of having the University, and drawing attention to the probability that the very block of stock which has brought such loss to the University had been previously owned by the State, so that the University is only bearing a burden which the State itself might otherwise have borne.

Mr. W. W. Allis, of Milwaukee, has given Columbia University the equipment for a steam engineering laboratory containing a number of valuable pieces of machinery valued at more than $15,000.

Miss Olivia Phelps Stokes has given Barnard College $5,000, the income of which is to be used for aiding poor students.

Mr. A. J. Balfour has informed the authorities of Cambridge University that a friend of his who desired to remain anonymous wished to give £2,000 for general university purposes, in four installments, the first of which has been paid.

DISCUSSION AND CORRESPONDENCE.

THE EASTERNMOST VOLCANOES OF THE UNITED STATES.

To the Editor of Science: In looking through Professor I. C. Russell's magnificent volume on the 'Volcanoes of North America,' I was surprised to see (page 129) the statements that 'No volcanoes sufficiently recent to be recognized by their topographic forms occur east of the sharply defined eastern border of the Cordilleran mountain series,' and on page 191 he also says that the volcanoes occur in the Cordilleran region west of the meridian of Denver. On Plate 5 a map is given showing the distribution of volcanoes in the United States, upon which none are given east of the Rio Grande except the Spanish Peaks.

These conclusions on the part of Professor Russell are erroneous and mar his otherwise excellent work, for some of the most beautiful and perfect volcanic craters in the United States occur in New Mexico, not only far east of the longitude of Denver, but fully 200 miles east of the true Rocky Mountain front, which extends between Trinidad and Las Vegas.* These, as

have been described by the writer,† consist of a group of craters lying to the south of Folsom Station, in an eroded plain at the foot of the older lava capped Trinidad Mesa, which extends eastward from the Rocky Mountains for

*A brief notice of Mount Capulin was published by Orestes St. John in 'Notes on the Geology of Northwestern New Mexico;' Bull. U. S. Geol. and Geog. Survey of the Territories, Vol. II., 1876.

†Bull. Geol. Soc. Am., Vol. 3, p. 99, 1891.

a hundred miles or more along the Colorado-New Mexican line. The most conspicuous of these craters is Mount Capulin, six miles south of Folsom Station. This, a beautiful cinder cone (altitude 9,000 feet), rises nearly 2,750 feet above the railroad, with a vast crater at its top nearly a mile in diameter, slightly broken down on its western side. From its summit many flows can be traced. To the southward, from six to twenty miles, there are several similar craters, while to the northward there are several smaller ones. Around these craters there are numerous surface flows of vesicular, ropy lava, extending eastward to within sight of the Texas line.

These are the easternmost known craters of the Rocky Mountain region, and their occurrence at the foot of the Raton plateau, near the western edge of the Llano Estacado, is interesting. The cinder cones are clearly of a more recent origin than the adjacent basaltic cap of the Raton plateau, for they are situated in an eroded valley between the main mesa and an outlier—the Sierra Grande—and at a lower altitude than either of them. They are also apparently more recent than the late Tertiary deposits of the Llano Estacado, the original surface of the lava resting upon the latter and not covered by it except in case of the wind-blown débris.

While these are the only craters of the United States which are east of the true Rocky Mountain front, there are other important ones lying east of the Rio Grande which have escaped Mr. Russell's notice, notably the Cerrito lying between Galisteo and the Rio Grande, consisting of several cones rising to nearly 1,000 feet above the plateau. Still to the southward in the great bolson desert, which lies between the Organ and Sacramento ranges of southern New Mexico, there is a comparatively recent volcanic cone from which a stream of mobile lava has flowed for sixty miles to the southward. There are also several other craters just west of the Rio Grande and El Paso, in southern New Mexico, which have escaped Professor Russell's notice.

The Folsom craters, east of the true Rocky Mountain front, are the ones which upset deductions which would otherwise be tenable concerning the occurrence of volcanic cones approximately along oceanic shore lines. A bulletin for the United States Geological Survey is being prepared upon the Folsom locality by Mr. S. Prentiss Baldwin, of Cleveland, Ohio, who, at my request, some years ago undertook a thorough exploration of that most interesting region.

In addition to the true cinder cone craters we have have specified, that portion of New Mexico east of the Coloradoan group of the Rocky Mountains (Snow Range) which ends abruptly near the latitude of Sante Fé, is unusually rich in older volcanic phenomena, such as superficial lava flows and old volcanic necks or stocks of the type of Mount Taylor or the Spanish Peak which Russell includes in his map as volcanoes and two of which, near Fort Union, he describes.

Besides the omission of the true craters of New Mexico, the work gives no reference to the old volcanic phenomena of the Texas region, such as occur so abundantly in the Trans-Pecos region, and to the eastward along the interior margin of the Coastal Plain, between Austin and Del Rio.

It would have made matters much clearer to the reader had Professor Russell used a series of symbols upon his map to distinguish the kinds of volcanoes there plotted, such as living craters, extinct craters and volcanic stocks representing the ruins of old craters.

The accompanying sketch of the Texas-New Mexican region giving supplementary data concerning the distribution of volcanic phenomena will be of value to the reader of the work. The black discs are true volcanic craters; the square stocks or necks of former craters, and the crosses, are laccolites.

Robert T. Hill.

LITERARY EMBRYOLOGY.

To the Editor of Science: In the *Atlantic* for this month is an article by Mr. Frederic Burk on the 'Training of Teachers.' On p. 553–554 occurs the following paragraph, in which I have ventured to italicize those parts which seem to me absolutely incorrect. It appears singular that in an article on *teaching*, severely criticising prevalent methods, there

should occur a very striking example of inaccurate *learning:*

"Embryology throws some suggestive light upon the radical difference of childhood from maturity. The human fœtus roughly follows the disjointed line of development which marks the evolution of animal life. *Up to four months before birth the organism is essentially an aquatic animal, provided with rudimentary gill slits and the developed nerves of equilibration characteristic of aquatic life. At a later stage it has a coat of hair, and a tail longer than its legs, with the necessary muscles for moving this organ. This class of singular phenomena constantly appear during the embryological period; they are nourished and growing rapidly for a time, as if the whole destiny of the organism were to become some one of the lower forms of animal life.* Then the purpose is more or less suddenly changed. New forms and new organs appear, displacing or absorbing the old, and the organism seems to obtain a new destiny, which in turn may wholly or partly disappear. Some of these forms do not wholly disappear, *and physiologists now enumerate in the adult human organism more than one hundred parts of the body which have no known function,* and whose presence cannot be explained except upon the theory that they are remnants, or rudimentary organs, of some of these broken tendencies through which the organism has passed. Such is the pineal gland, which was declared by Descartes to be the seat of the soul, but is now recognized as the remnant of the organ of vision as still found in lower reptiles. The semi-lunar fold at the internal angle of the eye *is the remnant of the third eyelid of marsupials.* The vermiform appendage, which is such a menace to human life, is the remnant of an enormous organ in herbivora. The ear muscles, which in few people are functional, are recognized as rudiments of muscles of much use to lower animals. In the earlier stages of the human fœtus the brain is made up of three parts, of which the hinder part is by far the longest, as in the case of lower animals. *There is then no trace of the cerebral hemispheres* which constitute so large a part of the adult brain, *just as there is no trace in the lower orders. The mid-brain later shows the same enlargement for the centers of sight and hearing that these portions have in birds and certain fishes.* Still later the proportions are reversed: *the hind-brain dwindles away relatively, to become the slight enlargement of the spinal cord at the base of the brain known as the medulla oblongata; the mid-brain shrivels, to become the small nodules known as the quadrigemina; and the narrow neck connecting the fore-brain and the mid-brain swells, to become the huge cerebral hemispheres. Embryological growth is clearly not a harmonious development. The line of growth is broken, proceeding in one direction for a time, and then suddenly turning off in a new direction, as if the organism were continually making mistakes and correcting them before it is too late.* The path of growth is strewn with the remnants of these abandoned tendencies."

Charles S. Minot.

THE 'ENCHANTED MESA.'

To the Editor of Science: As little as he needs it, so little would I object that what trifling credit may be involved should go to my great teacher and dearest friend. Quite unthinkingly, however, I have mentioned the fact, in type, that I first published the Quéres tradition of the 'Enchanted Mesa;' and as Science (September 17) refers to the legend as discovered by Bandelier and 'subsequently obtained' by me, the pupil seems to be left in the position of trying to rob his master.

Bandelier's *Final Report*, Part II., p. 313, seems sufficiently conclusive, and accords with his fixed habit of giving credit, even to humble sources.

I first published a skeleton of the legend in 1885. It was years later before I could round out the last detail of the folk-story—when I had become genuinely a friend (by their count and my own) with nearly all the old *principales* of Acoma. One of them, a noble and wise old man, already tottering in his nineties, rode sixty miles horseback to pass three days with me in my own pueblo, in the month of his death. Both of us felt that it was good-bye; for I was already packing for the long South American journey with Bandelier, and the old man knew his own time was short. We talked of many things of the years that had drawn us together, and of Acoma, our common love; and

again he told me in full the folk-tale of the Mesa Encantada. No student of ethnology or of men, looking at that fine old face, listening to that voice, could ever have been so flippant as to suggest that he was telling 'a tall story.' He was repeating, word for word, the scriptures (we would say for a parallel) as he had learned them at his father's knee, and as they had been 'told down' from father to son through centuries. These folk-stories are not told to careless strangers, nor to careful ones either. How difficult it is to get them in full has been amply recorded by Bandelier and Cushing, and is fully understood by all who have genuinely gathered Indian folk-lore.

The matter of precedence is not vital, but since Mr. Hodge's workmanlike achievement the final 'round-up' of the rock of Katzimo seems to be on, and it is well to have all the mavericks duly marked. The Indian tradition is vindicated, and under circumstances that, in any less rigorous court than that of science, would be deemed dramatic.

CHAS. F. LUMMIS.

LOS ANGELES, CAL.

SCIENTIFIC LITERATURE.

Philosophy of Knowledge. An Inquiry into the Nature, Limits and Validity of Human Cognitive Faculty. By GEORGE TRUMBULL LADD, Professor of Philosophy in Yale University. New York, Charles Scribner's Sons. 1897. Pp. xv+614.

Professor Ladd's most widely known work has hitherto been done in the field of psychology. His *Elements of Physiological Psychology*, published ten years ago, was the first systematic account in English of the methods and results of that science. Since that time there have appeared from the pen of the same author, *Outlines of Physiological Psychology; Psychology, Descriptive and Explanatory; Philosophy of Mind* (an essay on the metaphysics of psychology); besides a work entitled *Introduction to Philosophy.* It has all along been evident to readers of Professor Ladd's works that his main interest is n those ultimate problems of theology and philosophy which are concerned with man's nature and destiny, and which demand for their answer some theory of his relation to other beings and to the ground of all reality. The author's procedure, however, as well as numerous explicit statements scattered throughout his writings, make it clear that he has considered it necessary to approach the discussion of these problems after a thorough study of the concrete facts regarding the nature of the human mind and its relation to the bodily organism. Professor Ladd's psychological labors thus furnish the basis for his philosophy. Having laid the foundation, he now proposes to see what structure can be erected upon it; or, as he himself expresses it, to show what is 'implicate' in the fact of human experience. It is the main business of the present volume to discuss the problems of knowledge; ontological questions are, in the main, reserved for future treatment. Nevertheless, as is pointed out, it is not possible to separate entirely ontology and epistemology. "Something as to the nature of the really existent is interwoven inextricably with the conscious life of the cognitive subject" (p. 348). Even in the present work, then, as we shall see later, a theory of reality is foreshadowed.

Before examining any of the doctrines of the book, it seems necessary to say a word regarding its spirit and purpose. The author's interest appears throughout to be practical quite as much as theoretical. "I have striven constantly," he says, "to make epistemology vital, —a thing of moment, because indissolubly and most intimately connected with the ethical and religious life of the age" (p. ix.). And it seems to him of the utmost importance to refute what he considers false and dangerous theories of knowledge. "The agnostic or despairing attitude towards the problem of knowledge itself lies, both logically and in fact, at the base of all other agnosticism, and of manifold forms of despair" (p. 28). If this conviction has sometimes led the author to adopt the language of a moral teacher or preacher, rather than that of an investigator, it has doubtless rendered his presentation more vigorous and his book more interesting, from the standpoint of the general reader, than would otherwise have been the case. It is probable, too, that in the author's consciousness of a mission is to be found the explanation of the remarkable statements in the

preface that 'there are no modern works in English from which any help is to be derived in the treatment of epistemological problems,' and that the present volume 'asks and should receive the treatment due to a pioneer work' (p. viii.). It is perhaps psychologically inevitable that the reformer should regard himself as standing alone, that he should be unable to see that there are other knees which have not bowed unto Baal. It will no doubt be encouraging to Professor Ladd to learn that, in spite of his conviction that no help is to be found in Mr. Hobhouse's recent work since it deals with logic (*vide*, note p. viii.), he may discover there a theory of knowledge similar in many respects to his own. There are also several other modern books on logic which cannot fairly be accused of treating the nature of thought in a merely formal way, and in which the fundamental conceptions which Professor Ladd himself uses are very clearly laid down. And among psychological writers there are surely several—Ward, James, Stout, to mention but three names—from whom some assistance might be derived in a discussion of the nature of cognition. My own opinion is that philosophers at the present day have some ground for encouragement and congratulation, in the fact that substantial agreement has been reached on so many important points connected with this very subject. While gladly acknowledging the independence and value of Professor Ladd's treatment, I should still say that it has been largely made possible by the work which has appeared in English during the last twenty years.

The first chapter of the volume is occupied with a discussion of the nature of the problem, while the two following chapters contain an excellent, though somewhat summary, account of historical theories of cognition. "The fundamental problem of the philosophy of knowledge is an inquiry into the relations between certain states of consciousness and what we conceive of as 'the really existing'" (p. 10). "It accepts as its problem cognition including all its necessary implicates" (p. 17). Among these implicates is that of an extra-mental reality different from the knowing subject. "To know is to make an ontological leap, a spring from the charmed circle of pure subjectivity into the mystery of the real" (p. 22). If we ask, now, how it is possible to guarantee the validity of knowledge, we find that it is impossible to discover any outside standard by means of which it may be tested. "Critical analysis of the nature of experience, with a view to certify it, ends in the discovery of aspects, or factors, or implicates, of every exercise of cognitive faculty which are self-certifying" (p. 105).

A point upon which great emphasis is laid is the objective nature of cognition. "It is the very reverse of truth to say that knowledge is *merely* subjective; for till the stream of consciousness, the state or the activity of the knowing subject, has become also objective, cognition has not taken place" (p. 115). Judgment, in which the cognitive activity involved in thinking culminates, "is not genuine judgment without a trans-subjective reference, an implication of the actual connection of different 'momenta' in a really existing world" (p. 149). Professor Ladd also strongly insists that knowing is not an affair of any one set of faculties, but involves the whole mind. Feeling and willing are implied in every cognitive act, and belong to the very nature of knowledge. Two chapters (Chap. vi., Knowledge as Feeling and Willing; and Chap. xvii., Ethical and Æsthetical Momenta of Knowledge) are devoted to enforcing and illustrating this doctrine, which is so often forgotten by those who discuss the nature of knowledge. "In the formation and criticism of every alleged cognitive judgment, the entire mind of the subject, whose is the judgment, takes part" p. 502). "The different aspects or sides of human nature do not stand apart, as it were, from the ordinary working of cognitive faculty. * * * The rather must they all be considered as factors, or 'momenta' essentially present and effective in the integrating process that gives the object as a totality to the mind, and that shapes the actual synthesis in which the cognitive judgment consists" (p. 503).

The author finds, further, that the reality of both subject and object, and also that of a relation between the two, are 'implicated' in every act of self-conscious experience. But how shall

we conceive of this relation? In cognition an obvious distinction of subject and object is presupposed. But their complete incomparability is denied, and their actual unification in some form is affirmed (p. 206). This unification can take place 'only if the conception of one of the two—either of thing or of self—can be so extended in a valid way as to provide an explanation for the other, and for the relation of knowledge between the two' (p. 216). The concept of the Self, the author finds, is alone capable of such extension. It furnishes the key or interpretation to all that we know about things. That is, it is only when things are conceived as in some sort analogous to the Self that they can be known at all. Our knowledge of the Self is direct and intuitive and has the highest degree of certainty. Indeed, it is because we fail to attain the same perfection in knowing, when dealing with things, that we become dissatisfied with the limits, etc., of our knowledge (p. 252). The author's doctrine on the nature of our knowledge of the Self requires further elaboration to render it perfectly clear. He seems, however, to believe that we here get beyond the antithesis of subject and object, and are, in a sense, face to face with reality. He himself sums up his chapter on the knowledge of Things and of Self as follows: "While the knowledge of Self may attain an intuitive penetration to the heart of reality, the knowledge of things remains an analogical interpretation of their apparent behavior into terms of a real nature corresponding, in important characteristics, to our own" (p. 226).

This conception of the Self as the central point of knowledge determines, to a very important extent, the character of the discussions which follow. The meaning of Identity and Difference and of the principle of Sufficient Reason are found in the nature of the Self. And, similarly, the author's conclusions regarding the teleological character of knowledge, and the necessity of employing teleology to understand completely the nature of things, follows directly from the doctrine that knowing is an interpretation of things by the Self in the light of what it knows about its own nature. The author's discussion of Experience and the Transcendent (Chap. xi.) is extremely interesting. We cannot, he argues, know anything that is not somehow implicate in our experience. But every experience implies the existence of conditions which transcend it as mere fact. Hence to know is just to reach beyond the mere factual aspect of experience to its underlying conditions (pp. 325–35).

The theory of reality outlined in the present volume shows marked traces of the influence of Lotze. No meaning can be given to the concept of related things "unless things are conceived of as self-active beings, with their various modes of behavior interdependent and yet united under a framework, so to speak, of immanent ideas" (p. 360). In the same way, the relation between the individual and the ground of reality is conceived as a relation of minds or selves. "Human cognition is all to be understood as a species of intercourse between minds. In all man's knowledge the real being of the finite Self is in actual commerce with the absolute Self. The relation of an intercourse between Selves is the one fundamental and permanent conception under which may be truthfully included all the particular forms of relation of which we have experience in the development of the life of cognition" (p. 558).

J. E. Creighton.

Cornell University.

Elementary Geology. By Ralph S. Tarr, B. S., F. G. S. A., Professor of Dynamic Geology and Physical Geography at Cornell University. New York, The Macmillan Company. 1897. Price, $1.40.

Occasion for the publication of another elementary text-book on geology, in addition to the number of good works previously available, is found in the 'need of a geology in which more stress is placed upon the dynamic aspect of the subject than is commonly given.' It is the author's opinion that stratigraphic geology—that is, as the term is used in this work, the history of the earth's development—contains too much abstract fact for the average high school student, whereas structural and dynamic geology, which treat respectively of the materials composing the earth's mass and the forces affecting it, may be presented in simpler form. "Here the body of fact necessary for

elementary understanding is not so great nor so difficult to grasp. The teachings of these truths of geology are illustrated on every hand, and in fact some of them are already familiar to the pupil before he enters upon the study. They deal with phenomena in the midst of which we dwell, and hence should become a part of the mental possessions of every high school pupil." The second reason for putting forth the book is to furnish a companion and adjunct to the 'Elementary Physical Geography,' by the same author.

There is much to be said for the view that in teaching geology a beginning can best be made with the study of the materials of the earth and the forces which modify it. Such a method transforms the study by substituting observation of our environment for book learning of past conditions. As the tendency of modern geologic interpretation is to seek in the records of the past for the effects of causes now operative, such a method is scientifically sound. Those who have found the author's work on 'Physical Geography' helpful will, no doubt, discover in this 'Elementary Geology' an aid to further studies.

To prepare an adequate elementary textbook is a task involving the successful reduction of three difficulties: the selection of material; the analysis of the subject-matter chosen, and the choice of language.

In the selection of material from the enormous mass of available facts the author determines the essential character of the book. This is his peculiar privilege, and detailed comment would only serve to illustrate another point of view. The choice for this volume is controlled by the emphasis given to the dynamic phase of the subject, and by the appropriate preference for American instances of world-wide phenomena.

With reference to the analysis of the subjects chosen and the precision of expression, more definite standards have been set by the masters of scientific exposition. Their example might well check too fluent thought and too facile pen. The present work is weak in analysis and statement. The writing is in a descriptive style, which is pleasant to read, but which lacks emphasis of leading ideas. Examples chosen to illustrate processes appear to have controlled the order of presentation rather than to have been controlled by a logical train of thought.

About one-hundred and fifty pages of the four hundred and eighty-seven are given to illustrations. The illustrations are, as a rule, well chosen, judging by those whose originals are familiar, but in reduction to a scale adequate for this work they have suffered very materially, and their value is in many instances doubtful Half-tone reductions printed as text figures rarely retain sufficient character to justify their use in works of this kind. The photograph should either be redrawn as line work or it should be printed upon a separate plate in a proper press. Either of these alternatives would limit the number of illustrations available for a book of moderate cost, but it would be better to have a few good ones than many which fail of their purpose.

The responsibility which rests upon the scientific author in attempting to promote the study of his subject can scarcely be too seriously considered. It is only in recognition of this responsibility that this review has been prepared.

BAILEY WILLIS.

NEW BOOKS.

Natural History. R. LYDEKKER and others. New York, D. Appleton & Co. 1897. Pp. xvi+771. $2.00.

Life Histories of American Insects. CLARENCE M. WEED. New York and London, The Macmillan Co. 1897. Pp. xii+272. $1.50.

Comparative Zoology. J. S. KINGSLEY. New York, Henry Holt & Co. 1897. Pp. vii+357.

Darwin and after Darwin. GEORGE JOHN ROMANES. Chicago, The Open Court Publishing Co. 1897. Vol. III. Pp. viii+181.

Laboratory Directions in General Biology. HARRIET RANDOLF. New York, Henry Holt & Co. 1897. Pp. vi+163.

Quantitative Chemical Analysis. PERCY NORTON EVANS. Boston and London, Ginn & Co. 1897. Pp. iv+80.

Kroll's Stereoskopische Bilder für Schielende. R. PERLIA. Hamburg, Leopold Voss. 1897. 26 colored pictures.

SCIENCE

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FRIDAY, OCTOBER 22, 1897.

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ADDRESS OF THE PRESIDENT TO THE PHYSIOLOGICAL SECTION OF THE BRITISH ASSOCIATION.

WE who have come from the little island on the other side of the great waters to take part in this important gathering of the British Association have of late been much exercised in retrospection. We have been looking back on the sixty years' reign of our beloved Sovereign, and dwelling on what has happened during her gracious rule. We have, perhaps, done little in calling to mind the wrongs, the mistakes and the failures of the Victorian era; but our minds and our mouths have been full of its achievements and its progress; and each of us, of himself or through another, has been busy in bringing back to the present the events of more than half a century of the past. It was while I, with others, was in this retrospective mood that the duty of preparing some few words to say to you to-day seemed suddenly to change from an impalpable cloud in the far distance to a heavy burden pressing directly on the back; and in choosing something to say I have succumbed to the dominant influence. Before putting pen to paper, however, I recovered sufficiently to resist the temptation to add one more to the many reviews which have appeared of the progress of physiology during the Victorian era. I also rejected the idea of doing that for which I find precedents in past presidential addresses—namely, of at-

tempting to tell what has been the history of the science to which a Section is devoted during the brief interval which has elapsed since the Section last met; to try and catch physiology, or any other science, as it rushes through the brief period of some twelve months seemed to me not unlike photographing the flying bullet without adequate apparatus; the result could only be either a blurred or a delusive image. But I bethought me that this is not the first, we hope it will not be the last, time that the British Association has met in the Western Hemisphere; and though the events of the thirteen years which have slipped by since the meeting at Montreal in 1884 might seem to furnish a very slender oat on which to pipe a presidential address, I have hoped that I might be led to sound upon it some few notes which might be listened to.

And indeed, though perhaps when we come to look into it closely almost every period would seem to have a value of its own, the past thirteen years do, in a certain sense, mark a break between the physiology of the past and that of the future. When the Association met at Montreal in 1884, Darwin, whose pregnant ideas have swayed physiology in the limited sense of that word, as well as that broader study of living beings which we sometimes call biology, as indeed they have every branch of natural knowledge, had been taken from us only some two years before, and there were still alive most of the men who did the great works of physiology of the middle and latter half of this century. The gifted Claude Bernard had passed away some years before, but his peers might have been present at Montreal. Bowman, whose classic works on muscle and kidney stand out as peaks in the physiological landscape of the past, models of researches finished and complete so far as the opportunities of the time would allow, fruitful beginnings and admirable guides for the labors of others. Brown-Sequard, who shares with Bernard the glory of having opened up the great modern path of the influence of the nervous system on vascular and thus on nutritional events, and who, if he made some mistakes, did many things which will last for all time. Brücke, whose clear judgment, as shown in his digestive and other work, gave permanent value to whatever he put forth. Du Bois-Reymond, who, if he labored in a narrow path, set a brilliant example of the way in which exact physical analysis may be applied to the phenomena of living beings, and in other ways had a powerful influence on the progress of physiology. Donders, whose mind seemed to have caught something of the better qualities of the physiological organ to which his professional life was devoted, and our knowledge of which he so largely extended, so sharply did he focus his mental eye on every physiological problem to which he turned—and these were many and varied. Helmholtz, whose great works on vision and hearing, to say nothing of his earlier distinctly physiological researches, make us feel that if physics gained much, physiology lost even more when the physiologist turned aside to more distinctly physical inquiries. Lastly, and not least, Ludwig, who by his own hands or through his pupils did so much to make physiology the exact science which it is to-day, but which it was not when he began his work. I say lastly, but I might add the name of one who, though barred by circumstances from contributing much directly to physiology by way of research, so used his powerful influence in many ways in aid of physiological interests as to have helped the science onward to no mean extent, at least among English-speaking people—I mean Huxley. All these might have met at Montreal. They have all left us now. Among the peers of the men I have mentioned whose chief labors were carried on in the forties, the fifties

and the sixties of the century, one prominent inquirer alone seems to be left, Albert von Kölliker, who in his old age is doing work of which even he in his youth might have been proud. The thirteen years which have swept the others away seem to mark a gulf between the physiological world of to-day and that of the time in which most of their work was done.

They are gone, but they have left behind their work and their names. May they of the future, as I believe we of the present are doing, take up their work and their example, doing work other than theirs but after their pattern, following in their steps.

In the thirteen years during which these have passed away physiology has not been idle. Indeed, the more we look into the period the more it seems to contain.

The study of physiology, as of other sciences, though it may be stimulated by difficulties (and physiology has the stimulus of a special form of opposition unknown to other sciences), expands under the sunshine of opportunity and aid. And it may be worth while to compare the opportunities for study of physiology in 1884 with those in 1897. At this meeting of the British Association I may fitly confine myself, I was going to say, to British matters; but I feel at this point, as others have felt, the want of a suitable nomenclature. We who are gathered here to-day have, with the exception of a few honored guests from the Eastern Hemisphere, one common bond, one common token of unity, and, so far as I know, one only; I am speaking now of outward tokens; down deeper in our nature there are, I trust, yet others. We all speak the English tongue. Some of us belong to what is called Great Britain and Ireland, others to that which is sometimes spoken of as Greater Britain. But there are others here who belong to neither; though English in tongue, they are in no sense British. To myself, to whom the being English in speech is a fact of far deeper moment than any political boundary, and who wish at the present moment to deal with the study of physiology among all those who speak the English tongue, there comes the great want of some word which will denote all such. I hope, indeed I think, that others feel the same want too. The term Anglo-Saxon is at once pedantic and incorrect, and yet there is none other; and, in the absence of such a better term, I shall be forgiven if I venture at times to use the seemingly narrow word English as really meaning something much broader than British in its very broadest sense.

Using English in this sense, I may, I think, venture to say that the thirteen years which separate 1884 from to-day have witnessed among English people a development of opportunities for physiological study such as no other like period has seen. It is not without significance that only a year or two previous to this period, in England proper, in little England, neither of the ancient Universities of Oxford and Cambridge, which, historically at least, represent the fullest academical aspirations of the nation, possessed a chair of physiology; the present professors, who are the first, were both appointed in 1883. Up to that time the science of physiology had not been deemed worthy, by either university, of a distinctive professorial mechanism. The act of these ancient institutions was only a manifestation of modern impulses, shared also by the metropolis and by the provinces at large. Whereas up to that time the posts for teaching physiology, by whatever name they were called, had been in most cases held by men whose intellectual loins were girded for other purposes than physiology, and who used the posts as stepping-stones for what they considered better things, since that time, as each post became vacant, it had almost invariably been filled by men wishing and pur-

posing at least to devote their whole energies to the science. Scotland, in many respects the forerunner of England in intellectual matters, had not so much need of change; but she, too, has moved in the same direction, as has also the sister island.

And if we turn to this Western Continent, we find in Canada and in the States the same notable enlargement of physiological opportunity, or even a still more notable one. If the English-speaking physiologist dots on the map each place on this Western Hemisphere which is an academic focus of his science, he may well be proud of the opportunities now afforded for the development of English physiology; and the greater part of this has come within the last thirteen years.

Professorial chairs or their analogues are, however, after all but a small part of the provision for the development of physiological science. The heart of physiology is the laboratory. It is this which sends the life-blood through the frame; and in respect to this, perhaps, more than to anything else, has the progress of the past thirteen years been striking. Doubtless, on both sides of the waters there were physiological laboratories, and good ones, in 1884; but how much have even these during that period been enlarged and improved, and how many new ones have been added? In how many places, even right up to about 1884, the professor or lecturer was fain to be content with mere lecture experiments and a simple course of histology, with perhaps a few chemical exercises for his students! Now each teacher, however modest his post, feels and says that the authorities under whom he works are bound to provide him with the means of leading his students along the only path by which the science can be truly entered upon, that by which each learner repeats for himself the fundamental observations on which the science is based.

But there is a still larger outcome from the professorial chair and the physiological laboratory than the training of the student; these are opportunities not for teaching only, but also for research. And perhaps in no respect has the development during the past thirteen years been so marked as in this. Never so clearly as during this period has it become recognized that each post for teaching is no less a post for learning, that among academic duties the making knowledge is as urgent as the distributing it, and that among professorial qualifications the gift of garnering in new truths is at least as needful as facility in the didactic exposition of old ones. Thirteen years has seen a great change in this matter, and the progress has been perhaps greater on this side of the water than on the other, so far as English-speaking people are concerned. We on the other side have witnessed with envy the establishment on this side of a university, physiology having in it an honored place, the keynote of which is the development of original research. It will, I venture to think, be considered a strong confirmation of my present theme that the Clark University at Worcester was founded only ten years ago.

And here, as an English-speaking person, may I be allowed to point out, not without pride, that these thirteen years of increased opportunity have been thirteen years of increased fruitfulness. In the history of our science, among the names of the great men who have made epochs, English names, from Harvey onwards, occupy no mean place; but the greatness of such great men is of no national birth; it comes as it lists, and is independent of time and of place. If we turn to the more everyday workers, whose continued labors more slowly build up the growing edifice and provide the needful nourishment for the greatness of which I have just spoken, we may, I will dare to say, affirm that the last thirteen

years has brought contributions to physiology, made known in the English tongue, which, whether we regard their quanity or their quality, significantly outdo the like contributions made in any foregoing period of the same length. Those contributions have been equally as numerous, equally as good on this side as on the other side of the waters. And here I trust I shall be pardoned if personal ties and affection lead me to throw in a personal word. May I not say that much which has been done on this side has been directly or indirectly the outcome of the energy and gifts of one whom I may fitly name on an occasion such as this, since, though he belonged to the other side, his physiological life was passed and his work was done on this side, one who has been taken from us since this Association last met, Henry Newell Martin?

Yes, during these thirteen years, if we put aside the loss of comrades, physiology has been prosperous with us and the outlook is bright; but, as every cloud has its silver lining, so shadow follows all sunshine, success brings danger, and something bitter rises up amid the sweet of prosperity. The development of which I have spoken is an outcome of the progressive activity of the age, and the dominant note of that activity is heard in the word 'commercial.' Noblemen and noblewomen open shop, and every one, low as well as high, presses forward towards large or quick profits. The very influences which have made devotion to scientific inquiry a possible means of livelihood, and so fostered scientific investigation, are creating a new danger. The path of the professor was in old times narrow and strait, and only the few who had a real call cared to tread it; nowadays there is some fear lest it becomes so broad and so easy as to tempt those who are in no way fitted for it. There is an increasing risk of men undertaking a research, not because a question is crying out to them to be answered, but in the hope that the publication of their results may win for them a lucrative post. There is, moreover, an even greater evil ahead. The man who lights on a new scientific method holds the key of a chamber in which much gold may be stored up; and strong is the temptation for him to keep the new knowledge to himself until he has filled his fill, while all the time his brother-inquirers are wandering about in the dark through lack of that which he possesses. Such a selfish withholding of new scientific truth is beginning to be not rare in some branches of knowledge. May it never come near us!

Now I will, with your permission, cease to sound the provincial note, and ask your attention for a few minutes while I attempt to dwell on what seem to me to be some of the salient features of the fruits of physiological activity, not among English-speaking people only, but among all folk, during the past thirteen years.

When we review the records of research and discovery over any lengthened period, we find that in every branch of the study progress is irregular, that it ebbs and flows. At one time a particular problem occupies much attention, the periodicals are full of memoirs about it, and many of the young bloods flash their maiden swords upon it. Then again for a while it seems to lie dormant and unheeded. But quite irrespective of this feature, which seems to belong to all lines of inquiry, we may recognize two kinds of progress. On the one hand, in such a period, in spite of the waves just mentioned, a steady advance continually goes on in researches which were begun and pushed forward in former periods, some of them being of very old date. On the other hand, new lines of investigation, starting with quite new ideas or rendered possible by the introduction of new methods, are or may be begun. Such nat-

urally attract great attention, and give a special character to the period.

In the past thirteen years we may recognize both these kinds of progress. Of the former kind I might take, as an example, the time-honored problems of the mechanics of the circulation. In spite of the labor which has been spent on these in times of old, something always remains to be done, and the last thirteen years have not been idle. The researches of Hürthle and Tigerstedt, of Roy and Adami, not to mention others, have left us wiser than we were before. So again, with the also old problems of muscular contraction, progress, if not exciting, has been real ; we are some steps measurably nearer understanding what is the exact nature of the fundamental changes which bring about contraction and what are the relations of those changes to the structure of muscular fibre. In respect to another old problem, too, the beat of the heart, we have continued to creep nearer and nearer to the full light. Problems again, the method of attacking which is of more recent origin, such as the nature of secretion, and the allied problem of the nature of transudation, have engaged attention and brought about that stirring of the waters of controversy which, whatever be its effects in other departments of life, is never in science wholly a waste of time, if indeed it be a waste of time at all, since, in matters of science, the tribunal to which the combatants of both sides appeal is always sure to give a true judgment in the end. In the controversy thus arisen, the last word has perhaps not yet been said, but whether we tend at present to side with Heidenhain, who has continued into the past thirteen years the brilliant labors which were, perhaps, the distinguishing features of physiological progress in preceding periods, and who in his present sufferings carries with him, I am sure, the sympathies, if not the hopes, of all his brethren, or whether we are more inclined to join those who hold different views, we may all agree in saying that we have, in 1897, distinctly clearer ideas of why secretion gathers in an alveolus or lymph in a lymph space than we had in 1884.

I might multiply such examples of progress on more or less old lines until I wearied you; but I will try not to do so. I wish rather to dwell for a few minutes on some of what seems to be the salient new features of the period under review.

One such feature is, I venture to think, the development of what may perhaps be called the new physiological chemistry. We always are, and for a long time have been, learning something new about the chemical phenomena of living beings. During the years preceding those immediately recent, great progress, for which we have especially, perhaps, to thank Kühne, was made in our knowledge of the bodies which we speak of as proteids and their allies. But while admitting to the full the high value of all these researches, and the great light which they threw on many of the obscurer problems of the chemical changes of the body, such, for instance, as the digestive changes and the clotting of blood, it could not but be felt that their range was restricted and their value limited. Granting the extreme usefulness of being able to distinguish bodies though their solution or precipitation by means of this or that salt or acid, this did not seem to promise to throw much light on the all-important problem as to what was the connection between the chemical constitution of such bodies and their work in the economy of a living being. For it need not be argued that this is an all-important problem. To-day, as yesterday and in the days before, the mention of the word vitalism or its equivalent separates as a war-cry physiologists into two camps, one contending that all the phenomena of life can, and

the other that they cannot, be explained as the result of the action of chemico-physical forces. For myself, I have always felt that while such a controversy, like other controversies as I ventured to say just now, is useful as a stirring of the waters, through which much oxygen is brought home to many things and no little purification effected, the time for the final judgment on the question will not come until we shall more clearly understand than we do at present what we mean by physical and chemical, and may, perhaps, be put off until somewhere near the end of all things, when we shall know as fully as we ever shall what the forces to which we give these names can do and what they cannot. Meanwhile, the great thing is to push forward, so far as may be, the chemical analysis of the phenomena presented by living beings. Hitherto the physiological chemists, or the chemical physiologists as perhaps they ought rather to be called, have perhaps gone too much their own gait, and have seemed to be constructing too much a kind of chemistry of their own. But that, may I say, has in part been so because they did not receive from their distinctly chemical brethren the help of which they were in need. May I go so far as to say that to us physiologists these our brethren seemed to be lagging somewhat behind, at least along those lines of their science which directly told on our inquiries? That is, however, no longer the case. They are producing work and giving us ideas which we can carry straight into physiological problems. The remarkable work of Emil Fischer on sugars, one of the bright results of my period of thirteen years, may fully be regarded as opening up a new era in the physiology of the carbohydrates; opening up a new era because it has shown us the way how to invesigate physiological problems on purely and distinctively chemical lines. Not in the carbohydrates only, but in all directions our younger investigators are treating the old problems by the new chemical methods; the old physiological chemistry is passing away; nowhere, perhaps, is the outlook more promising than in this direction; and we may at any time receive the news that the stubborn old fortress of the proteids has succumbed to the new attack.

Another marked feature of the period has been the increasing attention given to the study of the lower forms of life, using their simpler structures and more diffuse phenomena to elucidate the more general properties of living matter. During the greater part of the present century physiologists have, as a rule, chosen as subjects of their observations almost exclusively the vertebrata; by far the larger part of the results obtained during this time have been gained by inquiries restricted to some half a dozen kinds of backboned animals; the frog and the myograph, the dog and the kymograph, have almost seemed the alpha and the omega of the science. This has been made a reproach by some, but, I cannot help thinking, unjustly. Physiology is, in its broad meaning, the unravelling of the potentialities of things in the conditions which we call living. In the higher animals the evolution by differentiation has brought these potentialities, so to speak, near the surface, or even laid them bare as actual properties capable of being grasped. In the lower animals they still lie deep buried in primeval sameness; and we may grope among them in vain unless we have a clue furnished by the study of the higher animal. This truth seems to have been early recognized during the progress of the science. In the old time, observers such as Spallanzani, with but a moderate amount of accumulated knowledge behind them, and a host of problems before them, with but few lines of inquiry as yet definitely laid down, were free to choose the subjects of their investigation where they pleased, and in the

wide field open to them prodded, so to speak, among all living things, indifferent whether they possessed a backbone or no. But it soon became obvious that the study of the special problems of the more highly organized creature was more fruitful, or at least more easily fruitful, than that of the general problems of the simpler forms; and hence it came about that inquiry, as it went on, grew more and more limited to the former. But an increasing knowledge of the laws of life as exemplified in the differentiated phenomena of the mammal is increasingly fitting us for a successful attack on the more general phenomena of the lowly creatures possessing little more than that molecular organization, if such a phrase be permitted, which alone supplies the conditions for the manifestation of vital activities. And, though it may be true that in all periods men have from time to time labored at this theme, I think that I am not wrong in saying that the last dozen years or so mark a distinct departure both as regards the number of researches directed to it, and also, what is of greater moment, as regards the definiteness and clearness of the results thereby obtained. One has only to look at the results recorded in the valuable treatises of Verworn and Biedermann, whether obtained by the authors themselves or by others, to feel great hope that in the immediately near future a notable advance will be made in our grasp of the nature of that varying collection of molecular conditions, potencies and changes, slimy hitherto to the intellectual no less than to the physical touch, which we are in the habit of denoting by the more or less magical word protoplasm. And, perhaps, one happy feature of such an advance will be one step in the way of that reintegration which men of science fondly hope may ultimately follow the differentiation of studies now so fierce and attended by many ills; in the problems of protoplasm the animal physiologist touches hands with the botanist, and both find that under different names they are striving towards the same end.

Closely allied to and, indeed, a part of the above line of inquiry is the study of the physiological attributes of the cell and of their connection with its intrinsic organization. This is a study which, during the last dozen years, has borne no mean fruits; but it is an old study, one which has been worked at from time to time, reviving again and again as new methods offered new opportunities. Moreover, it will probably come directly before us in our sectional work, and, therefore, I will say nothing more of it here.

Still another striking feature of the past dozen years has been the advance of our knowledge in regard to those events of the animal body which we have now learned to speak of as 'internal secretion.' This knowledge did not begin in this period. The first note was sounded long ago in the middle of the century, when Claude Bernard made known what he called 'the glycogenic function of the liver.' Men, too, were busy with the thyroid body and the suprarenal capsules long before the meeting of the British Association at Montreal. But it was since then, namely in 1889, that Minkowski published his discovery of the diabetic phenomena resulting from the total removal of the pancreas. That, I venture to think, was of momentous value, not only as a valuable discovery in itself, but especially, perhaps, in confirming and fixing our ideas as to internal secretion, and in encouraging further research.

Minkowski's investigation possessed this notable feature, that it was clear, sharp and decided, and, moreover, the chief factor, namely sugar, was subject to quantitative methods. The results of removing the thyroid body had been to a large extent general, often vague, and in some cases uncertain; so much so as to justify, to a cer-

tain extent, the doubts held by some as to the validity of the conclusion that the symptoms witnessed were really and simply due to the absence of the organ removed. The observer who removes the pancreas has to deal with a tangible and measurable result, the appearance of sugar in the urine. About this there can be no mistake, no uncertainty. And the confidence thus engendered in the conclusion that the pancreas, besides secreting the pancreatic juice, effects some notable change in the blood passing through it, spread to the analogous conclusions concerning the thyroid and the suprarenal, and moreover suggested further experimental inquiry. By those inquiries all previous doubts have been removed; it is not now a question whether or no the thyroid carries on a so-called internal secretion; the problem is reduced to finding out what it exactly does and how exactly it does it. Moreover, no one can at the present day suppose that this feature of internal secretion is confined to the thyroid, the suprarenal and the pancreas; it needs no spirit of prophecy to foretell that the coming years will add to physiological science a large and long chapter, the first marked distinctive verses of which belong to the dozen years which have just passed away.

The above three lines of advance are of themselves enough to justify a certain pride on the part of the physiologist as to the share which his science is taking in the forward movements of the time. And yet I venture to think that each and all of these is wholly overshadowed by researches of another kind, through which knowledge has made, during the past dozen years or so, a bound so momentous and so far-reaching that all other results gathered in during the time seem to shrink into relative insignificance.

It was a little before my period, in the year 1879, that Golgi published his modest note, 'Un nuovo processo di technica microscopia.'* That was the breaking out from the rocks of a little stream which has since swollen into a great flood. It is quite true that long before a new era in our knowledge of the central nervous system had been opened up by the works of Ferrier and of Fritch and Hitzig. Between 1870 and 1880 progress in this branch of physiology had been continued and rapid. Yet that progress had left much to be desired. On the one hand, the experimental inquiries, even when they were carried out with the safeguard of an adequate psychical analysis of the phenomena which presented themselves, and this was not always the case, sounded a very uncertain note, at least when they dealt with other than simply motor effects. They were, moreover, not unfrequently in discord with clinical experience. In general the conclusions which were arrived at through them, save such as were based on the production of easily recognized and often measurable movements, were regarded by many as conclusions of the kind which could not be ignored, which demanded respectful attention, and yet which failed to carry conviction. It seemed to be risking too much to trust too implicitly to the apparent teaching of the results arrived at; something appeared wanting to give these their full validity, to explain their full and certain meaning by showing their connection with what was known in other ways and by other methods. On the other hand, during nearly all this time, in spite of the valuable results acquired by the continually improving histological technique, by the degeneration method and by the developmental method, by the study of the periods of myelination, most of us, at all events, were sitting down, as our forefathers had done, before the intricate maze of encephalic structure, fascinated by its complexity, but

*_Rendiconti del reale Istitulo Lombardo_, Vol. XII., p. 206.

wondering what it all meant. Even when we attempted to thread our way through the relatively simple tangle of the spinal cord, to expect that we should ever see our way so to unravel out the strands of fibres, here thick, there thin, now twisting and turning, and anon running straight, or so to set out in definite constellations the seeming milky way of star-like cells, so to do this as to make the conformation of the cord explain the performances of which it is capable, appeared to be something beyond our reach. And when we passed from the cord to those cerebral structures the even gross topography of which is the despair of the beginner in anatomical studies, the multiple maze of gray and white matter seemed to frame itself into the letters graven on the gateway of the city of Dis, and bid us leave all hope behind.

What a change has come upon us during the past dozen years, and how great is the hope of ultimate success which we have to-day. Into what at the meeting at Montreal seemed a cloudy masss, in which most things were indistinct and doubtful, and into which each man could read images of possible mechanisms according as his fancy led, the method of Golgi has fallen like a clarifying drop, and at the present moment we are watching with interest and delight how that vague cloud is beginning to clear up and develop into a sharp and definite picture, in which lines objectively distinct and saying one thing only reveal themselves more and more. This is not the place to enter into details, and I will content myself with pointing out as illustrative of my theme the progress which is being made in our knowledge of how we hear and how sounds effect us. A dozen years ago we possessed experimental and clinical evidence which led us to believe that auditory impulses sweeping up the auditory nerve became developed into auditory sensations through events taking place in the temporo-sphenoidal convolution, and we had some indications that as these passed upward through the lower and middle brain the striæ acusticæ and the lateral fillet had some part to play. Beyond this we knew but little. To-day we can with confidence construct a diagram which he who runs can read, showing how the impulses undergoing a relay in the tuberculum acusticum and accessory nucleus pass by the striæ acusticæ and trapezoid fibres to the superior olive and trapezoid nucleus, and onwards by the lateral fillet to the posterior corpus quadrageminum and to the cortex of the temporo-sphenoidal convolution. And if much, very much, yet remains to be done even in tracking out yet more exactly the path pursued by the impulses, while they are yet still undeveloped impulses, not as yet lit up with consciousness, and in understanding the functional meaning of relays and apparently alternate routes, to say nothing of the deeper problems of when and how the psychical element intervenes, we feel that we have in our hands the clue by means of which we may hope to trace out clearly the mechanisms by which, whether consciousness plays its part or no, sounds affect so profoundly and so diversely the movements of the body, and haply some time or other to tell, in a plain and exact way, the story of how we hear. I have thus referred to hearing because the problems connected with this seemed, thirteen years ago, so eminently obscure; it appeared so preeminently hard a task, that of tracing out the path of an ordinary impulse through the confused maze of fibre and cell presented by the lower and middlebrain. Of the mechanism of sight we seemed even then to have better knowledge, but how much more clearly do we, so to speak, see vision now? So also with all other sensations, even those most obscure ones of touch and pain; indeed, all over the nervous system light seems breaking in a most remarkable way.

This great and significant progress we owe, I venture to say, to Golgi, to the method introduced by him; and I for one cannot help being glad that this important contribution to science, as well as another contingent and most valuable one, the degeneration method of Marchi, should be among the many tokens that Italy, the mother of all sciences in times gone by, is now once more taking her right place in scientific no less than in political life. We owe, I say, this progress to Golgi in the sense that the method introduced by him was the beginning of the new researches. We owe, moreover, to Golgi not the mere technical introduction of the method, but something more. He himself pointed out the theoretical significance of the results which his method produced; and if in this he has been outstripped and even corrected by others, his original merit must not be allowed to be forgotten. Those others are many, in many lands. The first, perhaps, was Frithiof Nansen, whose brief but brilliant memoir makes us selfish physiologists regret that the icy charms of the North Pole so early froze in him the bubbling springs of histological research. Of the rest two names stand out conspicuous. If rejuvenescent Italy invented this method, another ancient country, whose fame, once brilliant in the past, like that of Italy, suffered in later times an eclipse, produced the man who, above all others, has showed us how to use it. At the meeting at Montreal a voice from Spain telling of things physiological would have seemed a voice crying out of the wilderness; to-day the name of Ramon-y-Cayal is in every physiologist's mouth. That is one name, but there is yet another. Years ago, when those of us who are now veterans and see signs that it is time for us to stand aside were spelling out the primer of histology, one name was always before us as that of a man who touched every tissue and touched each well. It is a consoling thought to some of the elder ones that histological research seems to be an antidote to senile decay. As the companion of the young Spaniard in the pregnant work on the histology of the central nervous system done in the eighties and the nineties of the century, must be named the name of the man who was brilliant in the fifties, Albert von Kölliker.

When I say that the progress of our knowledge of the central nervous system during the past thirteen years has been largely due to the application of the method of Golgi, I do not mean that it, alone and by itself, has done what has been done. That is not the way of science. Almost every thrust forward in science is a resultant of concurrent forces working along different lines; and in most cases at least significant progress comes when efforts from different quarters meet and join hands. And especially as regards methods it is true that their value and effect depend on their coming at their allotted times. As I said above, neither experimental investigation nor clinical observation nor histological inquiry by the then known methods had been idle before 1880. They had, moreover, borne even notable fruits, but one thing was lacking for their fuller fruition. The experimental and clinical results all postulated the existence of clear definite paths for impulses within the central nervous system, of paths moreover which, while clear and sharp, were manifold and, under certain conditions, alternate or even vicarious, and were so constructed that the impulses as they swept along them underwent from time to time—that is, at some place or other—transformations or at least changes in nature. But the methods of histological investigations available before that of Golgi, though they taught us much, failed to furnish such an analysis of the tangle of gray and white matter as would clearly indicate the paths required. This

the method of Golgi did, or rather is doing. Where gold failed silver has succeeded, and is succeeding. Thanks to the black tract which silver when handled in a certain way leaves behind it in the animal body, as indeed it does elsewhere, we can now trace out, within the central nervous system, the pathway afforded by the nerve cell and the nerve cell alone. We see its dendrites branching out in various directions, each alert to dance the molecular dance assigned to it at once by the more lasting conditions which we call structural, and the more passing ones which we call functional, so soon as some partner touch its hand. We see the body of the cell with its dominant nucleus ready to obey and yet to marshal and command the figure so started. We see the neuraxon prepared to carry that figure along itself, it may be to far-distant parts, it may be to near ones, or to divert it along collaterals, it may be many, or it may be few, or to spread out at once among numerous seemingly equipollent branches. And whether it prove ultimately true or no that the figure of the dancing molecules sweeps always onwards along the dendrites towards the nucleus, and always outwards away from the nucleus along the neuraxon, or whatever way in the end be shown to be the exact differences in nature and action between the dendrites and the neuraxon, this at least seems sure, that cell plays upon cell only by such a kind of contact as seems to afford an opportunity for change in the figure of the dance, that is to say, in the nature of the impulse, and that in at least the ordinary play it is the terminal of the neuraxon (either of the main core or a collateral) of one cell which touches with a vibrating touch the dendrite or the body of some other cell. We can thus, I say, by the almost magic use of a silver token—I say magic use, for he who for the first time is shown a Golgi preparation is amazed to learn that it is such a sprawling thing as he sees before him which teaches so much, and yet when he comes to use it acquires daily increased confidence in its worth—it is by the use of such a silver token that we have been able to unravel so much of the intricate tangle of the possible paths of nervous impulses. By themselves, the acquisition of a set of pictures of such black lines would be of little value. But, and this I venture to think is the important point, to a most remarkable extent, and with noteworthy rapidity, the histological results thus arrived at, aided by analogous results reached by the degeneration method, especially by the newer method of Marchi, have confirmed or at times extended and corrected the teachings of experimental investigation and clinical observation. It is this which gives strength to our present position; we are attacking our problems along two independent lines. On the one hand we are tracing out anatomical paths, and laying bare the joints of histological machinery ; on the other hand, beginning with the phenomena, and analyzing the manifestations of disorder, whether of our own making or no, as well as of order, we are striving to delineate the machinery by help of its action. When the results of the two methods coincide, we may be confident that we are on the road of all truth ; when they disagree, the very disagreement serves as the starting-point for fresh inquiries along the one line or the other.

Fruitful as have been the labors of the past dozen years, we may rightly consider them as but the earnest of that which is to come ; and those of us who are far down on the slope of life may wistfully look forward to the next meeting of the Association on these Western shores, wondering what marvels will then be told.

Physiology, even in the narrower sense to which, by emphasis on the wavering barrier which parts the animal from the plant, it is restricted in this Section, deals

with many kinds of being, and with many things in each. But, somewhat as man, in one aspect a tiny fragment of the world, still more of the universe, in another aspect looms so great as to overshadow everything else, so the nervous system, seen from one point of view, is no more than a mere part of the whole organism, but, seen from another point of view, seems by its importance to swallow up all the rest. As man is apt to look upon all other things as mainly subserving his interests and purposes, so the physiologist, but with more justice, may regard all the rest of the body as mainly subserving the welfare of the nervous system; and, as man was created last, so our natural knowledge of the working of that nervous system has been the latest in its growth. But, if there be any truth in what I have urged today, we are witnessing a growth which promises to be as rapid as it has seemed to be delayed. Little spirit of prophecy is needed to foretell that in the not so distant future the teacher of physiology will hurry over the themes on which he now dwells so long, in order that he may have time to expound the most important of all the truths which he has to tell, those which have to do with the manifold workings of the brain.

And I will be here so bold as to dare to point out that this development of his science must, in the times to come, influence the attitude of the physiologist towards the world, and ought to influence the attitude of the world towards him. I imagine that if a plebiscite, limited even to instructed, I might almost say scientific, men, were taken at the present moment, it would be found that the most prevalent conception of physiology is that it is a something which is in some way an appendage to the art of medicine. That physiology is, and always must be, the basis of the science of healing, is so much a truism that I would not venture to repeat it here were it not that some of those enemies, alike to science and humanity, who are at times called anti-vivisectionists, and whose zeal often outruns, not only discretion, but even truth, have quite recently asserted that I think otherwise. Should such a hallucination ever threaten to possess me, I should only have to turn to the little we yet know of the physiology of the nervous system and remind myself how great a help the results of pure physiological curiosity—I repeat the words, pure physiological curiosity, for curiosity is the mother of science—have been, alike to the surgeon and the physician, in the treatment of those in some way most afflicting maladies, the diseases of the nervous system. No, physiology is, and always must be, the basis of the science of healing; but it is something more. When physiology is dealing with those parts of the body which we call muscular, vascular, glandular tissues and the like, rightly handled she points out the way not only to mend that which is hurt, to repair the damages of bad usage and disease, but so to train the growing tissues and to guide the grown ones as that the best use may be made of them for the purposes of life. She not only heals, she governs and educates. Nor does she do otherwise when she comes to deal with the nervous tissues. Nay, it is the very prerogative of these nervous tissues that their life is above that of all the other tissues, contingent on the environment and susceptible of education. If increasing knowledge gives us increasing power so to mould a muscular fibre that it shall play to the best the part which it has to play in life, the little knowledge we at present possess gives us at least much confidence in a coming far greater power over the nerve cell. This is not the place to plunge into the deep waters of the relation which the body bears to the mind; but this at least stares us in the face, that changes in

what we call the body bring about changes in what we call the mind. When we alter the one, we alter the other. If, as the whole past history of our science leads us to expect, in the coming years a clearer and deeper insight into the nature and condition of that molecular dance which is to us the material token of nervous action, and a fuller, exacter knowledge of the laws which govern the sweep of nervous impulses along fibre and cell, give us wider and directer command over the moulding of the growing nervous mechanism and the maintenance and regulation of the grown one, then assuredly physiology will take its place as a judge of appeal in questions not only of the body, but of the mind; it will raise its voice not in the hospital and consulting-room only, but also in the senate and the school.

One word more. We physiologists are sorely tempted towards self-righteousness, for we enjoy that blessedness which comes when men revile you and persecute you and say all manner of evil against you falsely. In the mother-country our hands are tied by an Act which was defined by one of the highest legal authorities as a 'penal' Act; and though with us, as with others, difficulties may have awakened activity, our science suffers from the action of the State. And some there are who would go still farther than the State has gone, though that is far, who would take from us even that which we have, and bid us make bricks wholly without straw. To go back is always a hard thing, and we in England can hardly look to any great betterment for at least many years to come. But unless what I have ventured to put before you to-day be a mocking phantasm, unworthy of this great Association and this great occasion, England in this respect at least offers an example to be shunned alike by her offspring and her fellows.

MICHAEL FOSTER.

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CHEMISTRY AT THE BRITISH ASSOCIATION.

THE work of the Chemical Section of the British Association was inaugurated with the address of its President, Professor Ramsay: 'An Undiscovered Gas.' Starting with a discussion of the history of the various periodic relationships which have been shown to exist among the elements, and of the definition of the properties of unknown members of several of the Groups prior to their isolation, the attempt was made to establish the probability of the existence, and to prophesy the characteristics of an element, as yet unknown, forming a 'triad' with helium and argon. Between fluorine and manganese lies chlorine; between oxygen and chromium, sulphur; between nitrogen and vanadium, phosphorus; between carbon and titanium, silicon, etc. The intermediate element possesses an atomic weight greater, on the average, by 16 units than that of the lightest member of the triad, and less by 20 units than that of the heaviest. Between the lightest and the heaviest, therefore, the difference in atomic weight is approximately 36 units, which is also the difference between the accepted atomic weights of helium (4) and argon (40). "There should, therefore, be an undiscovered element between helium and argon, with an atomic weight 16 units higher than that of helium, and 20 units lower than that of argon, namely 20. And if this unknown element, like helium and argon, should prove to consist of monatomic molecules, then its density should be half its atomic weight, 10. And, pushing the analogy still farther, it is to be expected that this element should be as indifferent to union with other elements as the two allied elements."

Professor Ramsay next reviewed his various efforts to obtain the third member of the helium-argon triad. The most promising method—that of systematic diffusion of the individual gases—failed to show the

presence of any second gas in purified argon; from what has been known as 'pure helium,' however, this process finally isolated a heavier gas which showed the spectroscopic characteristics of argon. No experimental evidence has so far been obtained for a gas with a density of 10.

The address concludes with a discussion of the probable position of argon in the Periodic System, the argument being along the same lines as that previously put forward by the author in his work, 'The Gases of the Atmosphere.' Attention is called to the fact that the differences of the atomic weights of elements following one another in any one Series are quite irregular, varying in the Lithium Series from 1.0 to 3.0, in the Sodium Series from 1.0 to 3.5, etc. Again, in the Silver Series iodine undoubtedly follows tellurium, and yet all the recent determinations of the atomic weight of the latter element unite upon a figure almost a unit above that of iodine; just as density-determinations indicate an atomic weight for argon nearly one unit higher than that of potassium which *follows* it in the System. The author concludes that the relative weights of the atoms of elements, while indicating roughly their position in a perfect Periodic System, are not to be taken as the absolute criterion of their relative sequence. As it is not possible in this short review adequately to discuss this matter, the reader is referred to the author's own statement of the argument.*

In the course of the Meeting Professor Ramsay presented (1) a paper dealing with the process employed in the separation of gases of different densities by fractional diffusion, and (2)—for Mr. Morris Travers—a proof of the fact that the hydrogen evolved on heating minerals in a vacuum is due to the decomposition of water mechanically held and is not present in the form of any other compound. In a paper before the Physical Section he called attention to the great delicacy of refractivity-determinations as a means of deciding upon the purity of light gases.

*SCIENCE, Oct. 1st, pp. 493–502.

The superiority of the oxalate method for the separation of thorium from the other elements with which it is usually associated was demonstrated by Professor Brauner, who also presented the results obtained in a redetermination of the atomic weight of the metal. Professor T. W. Richards reviewed his recent very important work upon the atomic weights of cobalt and nickel, explaining the methods of purification of the salts employed and the apparatus in which they were got ready for weighing. Professor Meslans gave an interesting exhibition of the properties of free fluorine prepared according to the method of Moissan, but in a vessel of copper, instead of platinum, and surrounded by a freezing-mixture of ice and solid carbon dioxide. A very brief paper by Professors Moissan and Dewar on some of the physical constants of liquid fluorine was read by Professor Meldola.

Other papers on inorganic chemistry were those of Mr. E. C. C. Baly, on the formation of a compound when mercury falls in a finely divided state through an atmosphere of oxygen, and which appears to contain the oxygen in the form of ozone; of Dr. C. A. Kohn, on the electrolytic determination of copper and iron in oysters, reminiscent of the recent 'oyster scare' in Great Britain; of Professor W. W. Andrews, on the great increase in the rapidity and accuracy of blowpipe determinations through the use of tablets of plaster of Paris instead of charcoal; of Professor Dunnington, on the occurrence of titanic oxide in soils; and of F. T. Shutt, on analyses of Canadian virgin soils.

In the field of organic chemisty the most interesting paper—perhaps the most striking communication presented at this meeting of

the Association—was that of Professor Nef, on 'The Chemistry of Methylene,' only a portion of which, however, was read. The author, as a result of this and former work, claims among other things to have proved the existence of isomeric acetylenes, one of which is characterized by the presence of a bivalent carbon atom and should therefore be represented by the formula $= C : CH_2$. This substance and its derivatives are remarkable on account of their extraordinary instability, horrible odor and extremely poisonous properties—peculiarities shared in large measure by all compounds of bivalent carbon, among which the author includes the cyanides. By a continuation of the process of removing hydrogen, Professor Nef expects to isolate gaseous and liquid carbon, with molecular weights of 24 and 72, respectively! The publication of the full text of this remarkable paper will certainly be awaited with interest.

As the result of a careful research, Professor Freer brought forward further arguments in favor of the view advanced by Nef for the constitution of the aliphatic ketones and their metallic derivatives. Dr. Lehmann reported the production of benzene derivatives through the reduction of a 1:6 diketone formed by the condensation of benzil with two molecules of acetophenone. A paper on the 'Condensation-products of Aldehydes and Amides' was read by Dr. Kohn. A report of analyses of pre-carboniferous coals was presented by Professor W. H. Ellis.

Professor Roberts-Austen exhibited some photographs of the 'splash' produced by objects falling into molten metals, and intended to show the similarity of behavior in these and other liquids. Mr. Ramage explained a number of photographs of the spectra of minerals and metals, prepared by Professor Hartley and himself. Dr. W. L. Miller exhibited an apparatus designed to determine the vapor-tensions of liquid mixtures. Mr. W. L. T. Addison read a portion of an interesting paper on the formation of crystals. Short papers by Dr. Gladstone and Mr. Hibbert and by Dr. T. Waddell discussed the absorption of Röntgen rays by the light metals. The curious effects produced by certain metals upon a photographic plate when placed in contact with it, or even, in some cases, in its neighborhood, were discussed by Dr. W. J. Russell. In the mutual decomposition of hydrobromic and bromic acids, Professor James Walker finds an interesting case where the application of the theory of electrolytic dissociation furnishes a satisfactory explanation of the course taken by the reaction.

Two papers remain to be mentioned, that of Professor Andrews on 'Reform in the Teaching of Chemistry,' and that of Professor Meldola on 'The Rationale of Chemical Synthesis.' The latter was an attempt to find a common ground upon which the chemist and the physiologist could work, each along his own lines of research, and where, by united judicious effort, more rapid progress could be made into those mysterious regions now withholding from our eager quest so much of vast importance to mankind.

W. W. R.

GEOGRAPHY AT THE BRITISH ASSOCIATION.

The geographers of the United States and Canada have every reason to feel highly pleased with the reception given them at the Toronto meeting of the British Association. Every effort was made to have the visiting geographers feel that their hosts considered them, not guests, but fellow-workers. Nearly one-half of the general committee was composed of residents of North America, and one day was given over to papers concerning Canada and the United States. In all, nearly half of the papers presented were by Americans.

The National Geographic Society, of Washington, D. C., had made especial efforts to have America well represented, and much is due to its efforts. It is, however, to be regretted that there were so many papers of an historical character dealing with the geographic results of the several government bureaus of the United States and Canada, and so few papers on the one branch of geography in which America has done the most in the last few years, namely, Physiography. The absence of many of our best physiographers on official field duties partly accounts for the scarcity of such communications.

The meeting of the Section opened most auspiciously with a goodly attendance at the address of the President, Dr. J. Scott Keltie, Secretary of the Royal Geographical Society, and editor of the *Geographical Journal and Statesmen's Year Book.* Dr. Keltie's careful summary of the geographical results to date, and his outline of possible future work, has already been published in several places, and needs no further comment. The listening American was impressed with the heartfelt compliments that the author paid to the works of several Americans, and to the various United States government bureaus.

In the afternoon of the first day Sir George Robertson gave a very interesting and entertaining account of Kafiristan and the Kafirs, and his life among them. Mr. E. G. Ravenstein reported in brief the results of the Committee on the Climatology of Africa. The committee is continued with a grant of £10 from the Association. The two following papers were brief abstracts of recent investigations of the Physiography and Temperature of Nova Zembla and Spitzbergen.

The second day of the meeting was to have been devoted to educational papers, but there were not enough to fill the program. The day opened with a short paper by the writer on 'Scientific Geography for Schools,' a plea for the assistance of scientists in the planning and execution of geographical courses in schools for all grades. A brief summary was given by the President of the voluminous report of the Committee on Geographical Education, prepared by Mr. A. J. Herbertson. The Royal Geographical Society has within the last fourteen years accomplished a very great reform in geographical education, since the careful study of the conditions by Dr. Keltie brought attention to the matter. Other papers of the forenoon were by Lieutenant-Colonel Bailey, on 'Forestry in India.' Colonel Bailey gave a very interesting account of the present conditions of the forests and the methods of protection necessary, a paper that showed thorough familiarity with the subject at first hand. The indefatigable Recorder of the Section, Dr. Hugh R. Mill, who is also librarian of the Royal Geographical Society, presented a very thoughtful paper on the 'Classification of Geography,' based on the results of his labors in cataloguing. The last paper of the forenoon was by Mr. Vaughn Cornish, on the 'Distribution of Detritus by the Sea,' in which the author considered the ocean processes in much detail.

In the afternoon Professor John Milne, the seismologist, gave a very suggestive and interesting lecture on 'Certain Submarine Changes,' deduced from his study of earthquakes and the breaking of ocean cables. Professor Milne also gave a more popular and inclusive evening lecture before the whole Association, and other papers before the Geological Section, each of which presented many new thoughts of practical use to geologists and geographers. Mr. Ravenstein followed Professor Milne with a detailed account of the result of his studies concerning the Congo and the Cape of Good Hope from 1482 to 1488, and the first rounding of the Cape.

The third day was devoted to the geography of the United States and Canada, and the papers presented were mostly of a historical character, and included an account of the work of the various geographical institutions of the United States, by Marcus Baker; the Work of the United States Coast and Geodetic Survey, by Dr. T. C. Mendenhall; the Hydrography of the United States, by Mr. F. H. Newell; the Geographical Work of the United States Geological Survey, by Mr. C. D. Walcott; Geographical Work of the Canada Geological Survey, by Mr. C. J. White; the Work of the Canada Weather Bureau, by Mr. Stupart, and of the United States Weather Bureau, by Mr. Willis L. Moore.

Professor William M. Davis gave an account of the coastal plain of Maine. This paper epitomized the principles of the physiographic classification of land forms, and gave a careful account of the features of the coastal plain of Maine and its position in the classification, in spite of what appeared to be at first apparent anomalies. Mr. C. E. Lumsden entered a strong plea for the unification of time at sea, and showed the confusion arising from the present systems of time record employed by mariners. The paper of the day drawing the largest audience was that of the explorer and geographer, Dr. J. B. Tyrrell, who gave an interesting illustrated account of the Barren Lands of Canada. Some of the tales of game in this region of difficult traveling, though verified by the camera, were almost incredible.

The session of the fourth day, devoted to physical geography, opened with a large audience to greet the explorer and hunter, Mr. E. C. Selous, who gave a glowing account of the Economic Geography of Rhodesia, based on an intimate knowledge of about a quarter of a century. This paper added many data of value to those brought forth by the report of the Committee on Climatology of Africa, and was full of interest because of the present political condition of South Africa. Other papers of the morning were: 'A Journey in Tripoli,' by J. T. Myres; 'On the Direction of Lines of Structure in Eurasia,' by Prince Kropotkin; 'Potamology as a Branch of Geography,' by Professor A. Penck, and the 'Geographical Development of the Lower Mississippi,' by E. L. Corthell, concerning which it is impossible, for lack of space, to make separate note. Suffice it to say that these papers were among the most scientific of the physical geography papers, and were all of value. The afternoon session was again devoted to North America, with papers on 'Southeastern Alaska,' by Otto J. Klotz; 'The First Ascent of Mt. Lefroy and Mt. Aberdeen,' by Professor H. B. Dixon, and 'Mexico Felix and Mexico Deserta,' by O. H. Howarth. Recent exploration was well represented by the paper on Mt. Lefroy and Mt. Aberdeen, as these peaks had just been scaled for the first time within a few weeks of the meeting.

The last day was devoted to a geographical round up, and could not be classified. The principal paper, read by General A. W. Greely, was 'The Growth and Material Conditions of the United States,' prepared by Mr. Henry Gannett. Professor W. M. Davis spoke on the importance of geography as a university subject.

Though these papers were the only ones that were presented in the Section of Geography, they were not the only geographic papers before the Association; other papers pertaining to physical and anthropological geography were given in different Sections. When we consider the geographic papers *in toto*, we see that the meeting was memorable for the new geographic material presented. New ideas of political or physical geography were not all, however, that the visiting geographers carried away from Toronto. The contact with the

best geographers from abroad was of very great value, particularly to many of the younger men. On every hand good fellowship prevailed, and every one present felt a new impulse to work from the inspiration of the meeting. Many of the visitors took the trip to the western coast after the meeting, on which, according to reports, fully as great results geographically were obtained as at the meeting. Not only must Canada feel a new scientific movement of progress from the meeting, but the United States as well must join in the good to be obtained. The visitors from abroad all agreed that they had gained much from the trip more helpful than mere information. All the Americans trust that they have been able to give in return a part of what they have received, and that this international meeting may help the cause of geography on on both sides of the water.

Richard E. Dodge.

IS THE DENVER FORMATION LACUSTRINE OR FLUVIATILE?

The usual interpretation of stratified deposits refers them to accumulation beneath water, either in the sea or in lakes. But many observers have recognized the ability of rivers to form stratified deposits more or less extensive; hence the mere occurrence of stratification might suggest fluviatile as well as lacustrine or marine origin; and some other sign than stratification would be needed to distinguish among these several conditions of deposition. When fossils are contained in the strata it is commonly easy to determine at least whether they were of salt or fresh water origin; but when without fossils, or when containing only fresh water or land fossils, it may be still a question whether the deposits were formed in lakes or rivers. It has been perhaps assumed that river deposits must be local, while lacustrine deposits may be widespread; but the immense fluviatile deposits of the Indo-Gangetic plain must suffice to free the products of aggrading rivers from narrow bounds. Blandford's account of the vast deposits of waste in long sloping plains at the base of mountain ranges in the interior basins of Persia, as well as the description of similar accumulations in our western country, shows that extensive stratified deposits may be formed in regions where even rivers are not a constant or conspicuous agency; and the believer in the competency of small processes to produce great results if time enough is allowed would find it difficult to set limits to the area or thickness of formation of such origin.

The distinction between true lacustrine sediments and true fluviatile sediments may be made in part by their composition and structure and in part by their fossils. River deposits are of variable sequence, coarse and fine, evenly or unevenly arranged, cross-bedded, ripple-marked and sun-cracked. Mid-lake deposits are of fine texture and even structure, becoming coarse and irregular only near their margin. A characteristic lacustrine fauna, enclosed in mid-lake silts, should be easily distinguished from the mixture of land and water fauna that might be preserved in coarser lake-border deposits or in the coarse and fine strata of normal river deposits. In the absence of a fauna, it might be difficult to distinguish lake-border deposits from river deposits; there might indeed be difficulty in separating lacustrine silts from the fine silts of river flood-plains, if fossils were wanting.

Gilbert's interpretation of some of the newer deposits on the Plains of Colorado near the Arkansas river as of fluviatile origin, and the adoption of his idea by the geologists of Kansas for the eastward extension of the same formations, has recently given practical application to the above generalities. Penck gives in his *Morphologie* a number of European examples of deposits ordinarily called lacustrine, but which

he regards as fluviatile. And on my return home from a sight of the Plains this summer, the receipt of Monograph XXVII., U. S. G. S., on the Geology of the Denver Basin, by Emmons, Cross and Eldridge, suggests a further extension of the discussion. It is particularly with regard to the Arapahoe and Denver formations, in Colorado, that the conditions of origin seem open to another interpretation than that given by these authors ; for it is noticeable that a lacustrine origin seems to have been almost taken for granted, and that a fluviatile origin is not discussed.

The Arapahoe formation is thus introduced: "After an erosion of the Laramie beds * * *, a considerable fresh-water lake was formed and sedimentation again set in. What the exact area of this lake was it is not possible now to determine; * * * whether the lake was continuous along the mountain front or there were several small isolated basins it is as yet impossible to determine. * * * In it were deposited more than 600 to 800 feet of sediments. * * * Of these sediments the lower 50 to 200 feet were conglomerates, the upper 400 to 600 feet arenaceous clays. Vertebrate remains are found in both the conglomerates and the clays, more abundant and better preserved, however, in the latter." (P. 31, 32.)

The interval between the Arapahoe and Denver formations is thus described: "Between the deposition of the Arapahoe and Denver beds a considerable time-interval occurred, during which, as the record of the rocks shows, the Arapahoe lake was drained and the sediments deposited in its bottom were considerably eroded. The movement which caused the drainage of the lake was, as far as present indications go, rather local in its effects, and produced no important deformation of the beds already deposited. * * * This movement was succeeded, after a considerable lapse of time, by a depression sufficient to allow of the formation of a second lake in the Denver basin. * * * The nature of the depression which produced such lakes without admitting marine waters to any extent within the area affected is not readily conceivable, yet its effects are shown to have been widespread by the considerable thicknesses of fresh-water beds consisting largely of eruptive débris." (P. 32.)

The following description is given of the Denver deposits: "The beds deposited in the Denver Lake reached a thickness of over 1,400 feet along the flanks of the mountains, but were probably somewhat thinner toward the middle of the basin. * * * That the Denver beds were deposited in shallow waters is shown by the frequent cross bedding observable both in sandstone and conglomerate, and by the plant remains and standing tree stumps that abound at certain horizons. * * * The Archean material contains large boulders, and the sand grains are angular." (P. 33.)

The vertebrate paleontology of the Denver basin is treated by Professor Marsh in the later pages of the monograph. Nearly all of the typical vertebrate fossils of the Denver region here discussed "were essentially land animals, but not a few of them, especially of the Reptilia, lived near the water and there met their fate. The preservation of their remains was probably, without exception, due to their entombment beneath the waters of the great fresh-water lakes which existed in this region during Mesozoic and Cenozoic time." (P. 525.) The plants discussed by Knowlton are land plants, not lacustrine. The table of invertebrate fossils (p. 78, 79) gives none to the Arapahoe beds, and only six to the Denver beds, all of which imply 'fresh water,' and most of which suggest, according to my colleague, Dr. R. T. Jackson, a fluviatile rather than a lacustrine origin.

Now waiving for the time all reference to

the silty and probably lacustrine deposits on the plains farther east of the mountains than the region here described, may not all the facts of composition, structure and fossil contents, above set forth, be explained as well by fluviatile as by lacustrine conditions? Instead of assuming a series of warping and tilting movements by which lake basins were made and drained, is it not equally legitimate to assume changes of altitude, attitude, climate, drainage areas, etc., by which the rivers of the region altered their behavior from aggrading to degrading? The decision between these alternatives must, of course, not be attempted by an observer away from the ground; but in the meantime the lacustrine origin of the Arapahoe and Denver beds does not seem to be fully substantiated.

If they should finally be shown to be fluviatile, several corollaries that follow from the acceptance of a lacustrine origin would require modification. For example: "Movements of elevation and subsidence, rather of an epeirogenic or continental nature, are indicated by both Tertiary and Pleistocene deposits that have a lacustrine origin, since the present inclination of the plains region, which shows an average descent, in round numbers, of 10 feet to the mile from the foothill region to the valleys of the Missouri and Mississippi, would not admit of the holding of lake waters on its surface." (P. 40.) Fluviatile deposits are, on the other hand, characteristically inclined; and the present slope of the Plains may be not far different from their slope when the Arapahoe, Denver and later beds were formed, if they were spread out by aggrading rivers. I cannot help wondering whether even the peculiar cases of lapsing and overlapping strata, so well worked out by Eldridge about Golden and Boulder, may not find at least some part of their explanation by alterations of fluviatile accumulation and denudation, prompted by changes in grade, climate, drainage, area, etc., rather than depend altogether on movements of elevation and depression. The latter interpretation seems to postulate essential horizontality and rather regular continuity of strata at time of deposition; the latter permits or even requires significant declivity, inequality of thickness and irregularity of overlaps at time of deposition. Indeed, since the question of the fluviatile origin of some of the younger deposits on the Plains has been accepted by geologists familiar with that great field, the possibility of a fluviatile origin for some of the older formations springs to mind. The coarser and non-fossiliferous strata of the foothill belt in particular may, perhaps, be the fluviatile equivalents of finer and fossiliferous strata of lascustrine or marine origin farther eastward on the Plains.

W. M. Davis.

Cambridge, Mass., September, 1897.

THE GRANT SARCOPHAGUS.

On one of the most beautiful sites on the Island of Manhattan stands the mausolæum which the gratitude of a nation has erected to the memory of its illustrious hero.

The altar in this temple of the dead is the sarcophagus, beautiful and imposing in its severe simplicity. The stone out of which it is hewn is a dark red granite, quarried at Montello, Marquette county, Wisconsin.

Concerning the granite of this region Professor Allan D. Conover wrote:* "The rock shows almost no tendency to decompose. It has a medium grain, close texture, is of a bright pinkish color, and without sign of arrangement of the ingredients in lines. These are: Rather large flaked, pinkish, cleavable feldspar, predominating;

* Gannett's Report on the Building Stones of the United States and Statistics of the Quarry Industry for 1880.

somewhat granular, fine, pinkish, translucent quartz, abundant; and greenish-black mica sparsely scattered in blotches made up of very fine flakes. In places thin, light green epidote-colored seams occur.

"Though this granite may be somewhat difficult to obtain in dressable masses, it would probably make a very handsome and durable building and ornamental stone."

Cover and box were quarried from the same ledge of stone; in other words, the original was a monolith in the quarry. For ease of working, however, and in accordance with custom and usage, this monolith was cut up into pieces approximating to finished sizes before being sent from the quarry. About six months were needed to complete the work after it was begun.

It its entirety the sarcophagus weighs seventeen thousand pounds; the largest piece weighs nine thousand pounds. Its entire length is ten feet four inches; it is five feet six inches wide and four feet eight inches deep.

The pedestal on which it rests is made of dark gray granite from Quincy, Mass.

A fragment of the sarcophagus, analyzed by the writer, was found to have the following composition:

	Per cent.
Silica, SiO_2	75.40
Aluminum oxide, Al_2O_3	11.34
Iron oxide, Fe_2O_3	4.16
Calcium oxide, CaO	0.90
Potassium oxide, K_2O	6.44
Sodium oxide, Na_2O	1.76
	100.00.

Its specific gravity (17.5 °C.) is 2.635. The stone is a true granite, accepting as such granite having for its essential constituents quartz and potash feldspar. The feldspar is orthoclase, in which some of the potassium is replaced by sodium.

Mausolæum and sarcophagus were erected under the direction of C. W. Canfield, Esq., of the New England Monument Company, to whose courtesy the writer is indebted for the details given and for the fragment of the sarcophagus subjected to analysis.

FERDINAND G. WIECHMANN.

BOTANICAL NOTES.

BOTANICAL ACTIVITY IN JAPAN.

A RECENT bulletin of the Imperial University of Tokyo (College of Agriculture Bull., Vol. III., No. 3) indicates a degree of activity in the study of botanical problems which must challenge the respectful attention of botanists in Europe and America. It is not too much to say that the papers which appear in this bulletin are of a higher order of merit than are the papers in most of the similar bulletins from American universities, or colleges of agriculture. The titles alone are sufficient to indicate the high scientific value of the bulletin: 'On the origin of sake yeast (*Saccharomyces sake*),' 'Note on a grape wine fermented with sake yeast,' 'On the behavior of yeast at a high temperature,' 'On two new kinds of red yeast,' 'On Brom-albumin and its behavior to microbes,' 'On an important function of leaves,' 'On the behavior of active albumin as a reserve material during winter and spring,' 'On the physiological action of neutral sodium sulphite upon phænogams,' 'On the poisonous action of ammonium salts upon plants.' The most important paper is probably that by M. Suzuki on a function of leaves, in which the author summarizes the results of numerous experiments as follows: "The conclusion seems justified that reserve proteids in the leaves are decomposed into amido-compounds during the night, and the latter are transported from the leaves to the other parts of the plant. The migration of amido-compounds appears to proceed rapidly, as I have found no large quantity in the leaves

gathered in the morning. Thus an important function of the leaves is positively established. This function consists in facilitating the formation of proteids in all parts of the plants by the assimilation of nitrates, yielding thereby amido-compounds which are in all probability better sources for proteid formation than nitrates, in organs poorer in sugar and with a less energetic respiration process. A great advantage is thus gained for the stems, roots and fruits, in which the conditions for nitrate assimilation are less favorable than in the leaves. These amido-compounds produced are either asparagin, which, as I have shown in a former article, can be formed synthetically from ammonium salts as well as from nitrates, or they are the decomposition products of proteids formed in the assimilation of nitrates."

A BROADER STUDY OF LOCAL FLORAS.

It is a hopeful sign of a broadening conception of the work of the local botanist that we see in a recent plant catalogue issued by Professor McClatchie and entitled the 'Seedless Plants of Southern California.' We have so long been familiar with plant catalogues which include nothing more than the flowering plants, often innocently regarded by their compilers as quite completely representing the flora, that it is refreshing to find one in which the flowerless plants are enumerated, while the flower-bearing species are omitted.

Not content with such a departure from time-honored custom, the author prefaces his work with a descriptive synopsis of the classes and orders and freely introduces handy artificial keys to the genera, thus departing still more from the old-style treatment. The synopsis of the plant groups shows that the the author has been more than a mere cataloguer of forms. He has been a student of the groups of which the species are representatives. Accordingly we find that the sequence and limitations of classes and orders are considerably different from those of the ordinary text-books. For this the author has been criticized by some botanists, but we cannot agree with these critics. It will be far better for botany when local students put more rather than less thought into their work, and, instead of deprecating their attempts to make improvements in the general system, we should rather welcome them as hopeful indications that the day of the old-time compiler of bare lists of species, following blindly the prevailing system, is drawing to a close.

In the smaller matters, also, this list is strictly modern, as in the consistent use of metric units in all measurements, the decapitalization of all specific names, the use of trinomials (for varieties), the omission of the comma after the specific name, and the double citation of authorities in the case of species which have been removed from the genera in which they were first described.

Charles E. Bessey.

The University of Nebraska.

NOTES ON INORGANIC CHEMISTRY.

The *Jahrbuch für Mineralogie* contains further investigations, by C. Doelter, on the permeability of minerals for the X-rays. Phenacite (silicate of glucinum) is almost perfectly transparent, even more so than boric acid. Olivine and zoisite are, like calcite, almost opaque; vesuvianite slightly less so. Diopside and hiddenite, like topaz, are half transparent. Sphene is almost opaque, sapphire almost transparnt, the ruby hardly less so. A close relationship appears between the atomic weights and the permeability to the X-rays.

According to L. Davy in the *Comptes Rendus*, all authors who have studied the ancient working of tin in the west of Eu-

rope admit that it was far anterior to the occupation of the country by the Romans, and think that the mines of Abbaretz-Nozay were abandoned by the Gauls about the date of the Roman invasion.

In a pamphlet entitled *Gold Growth* (Cincinnati, The Robert Clarke Co.), Mr. John Jacob Wagner asks: "Does nature transmute silver into gold?" "If it does, can we derive and utilize such hints, from nature's operation, as will enable us to attain artificial transmutation?" The former question he answers in the affirmative in the pamphlet before us; to the latter he promises a reply 'in due time.' The basis of the author's argument is that gold in nature is always found associated with silver, and the ratio of gold to silver is not uniform. If silver never occurs without some gold, it follows that the gold has grown from the silver, and the varying proportions found in different mines are due to the length of time the growth has been going on. Hence in the older rocks the proportion of gold to silver is greater then in the later rocks. Pure gold can be separated from silver alloy; but the 'fine silver' resulting invariably contains gold. The inference is that the silver is 'growing' into gold. This pamphlet belongs to a class of writings by no means rare, the efforts of laymen to clear up facts and theories which are far from clear to specialists who have devoted their lives to them. Granted that the premises of the writer are true, his deductions would have no weight to a chemist. He finds not merely silver and gold occurring together, but many other elements always associated with each other. If gold 'grows' from silver, why not potassium from sodium, or bromin from chlorin, etc.? The only difficulty with the theory is that at present there is absolutely no evidence of facts to support it, and the wisest chemists hesitate to philosophize on the problem of the genesis of the elements. It may be questioned if books, such as that before us, have any value; certainly they have not from a scientific standpoint.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE DEDICATION OF THE YERKES ASTRONOMICAL OBSERVATORY.

The University of Chicago has made very complete arrangements for exercises in connection with the dedication of the Yerkes Astronomical Observatory, to continue throughout the present week. The arrangements are as follows:

October 18, Monday.

2:30 p. m. Fourth Annual Meeting of the Board of Editors of the *Astrophysical Journal.*

4:30 p. m. Opening session of conferences. Informal talks on recent investigations, including:

Assistant Professor F. L. O. Wadsworth (Astrophysicist, Yerkes Observatory), on the application of Diffraction Phenomena to Astronomical and Astrophysical Measurements.

Dr. G. F. Hull (Professor of Physics, Colby University), on Electric Radiation.

7:30 p. m. Assistant Professor Wadsworth will demonstrate with the 40-inch Yerkes telescope the application of interference methods to astronomical measurements.

Professor Burnham will show selected double stars with the 40-inch telescope.

October 19, Tuesday.

9:00 a. m. Second session of conferences.

Dr. Henry Crew (Professor of Physics, Northwestern University), on the Source of the Characteristic Spectrum of the Metallic Arc.

Dr. Henri Deslandres (Astrophysicist, Paris Observatory), on a subject to be announced later.

Dr. W. J. Humphreys (University of Virginia), on the effect of Pressure on Wave-length.

Professor James E. Keeler (Director of the Allegheny Observatory), on the Spectra of Stars of Secchi's Third Type.

Professor H. C. Lord (Director of the Emerson McMillin Observatory, Ohio State University), on Researches in Stellar Spectography.

Professor Carl Runge (Director of the Spectroscopic Laboratory, Technische Hochschule, Hannover), on Oxygen in the Sun.

Professor Ormond Stone (Director of the Leander McCormick Observatory, University of Virginia), on the Great Nebula of Orion.

2:15 p. m. Address on the Yerkes Observatory by Professor George E. Hale, Director.

3:00 p. m. Professor Hale and Mr. Ellerman will show various solar phenomena with the 40-inch Yerkes telescope, including the chromosphere and prominences, the reversal of the H and K lines in prominences and faculæ, the duplication of the D_3 line, etc.

Experimental demonstrations will be given in the Observatory laboratories as follows:

Experiments with the rotating arc, Professor Crew.

Analysis of electric radiation by means of the interferometer, Professor Hull.

The effect of pressure on wave-length, Dr. Humphreys.

Measurements of wave-lengths in the infra-red spectrum, Assistant Professor Wadsworth.

Demonstrations in the Optical Shop, and in the Instrument Shop.

7:30 p. m. Professor Barnard will show with the 40-inch Yerkes telescope:

N. G. C. 224 (Andromeda Nebula).
N. G. C. 598.
N. G. C. 1976 (Orion Nebula).
N. G. C. 2245 (cometary nebula).
N. G. C. 2392 (planetary nebula).
N. G. C. 6543 (planetary nebula).
N. G. C. 6618 (Swan nebula).
N. G. C. 6720 (annular nebula).
N. G. C. 7009 ('Saturn' nebula).
N. G. C. 7078 (globular cluster).
R. Leporis (Hind's crimson star).
Selected variable stars.

The 12-inch refractor and 24-inch reflector will be used for miscellaneous observations.

OCTOBER 20, WEDNESDAY.

Professor George C. Comstock (Director of the Washburn Observatory, University of Wisconsin), on Determination of Stellar Parallax, and on Investigations of the Lunar Atmosphere.

Professor C. L. Doolittle(Director of the Flower Observatoy, University of Pennsylvania), on the Latitude Work of the Flower Observatory.

Father Hedrick (Astronomer, Georgetown College Observatory), on the Photochronograph.

Professor H. S. Pritchett (Director of the Observatory, Washington University,) on Personal Equation in Longitude Determination.

Dr. Charles L. Poor (Associate Professor of Astronomy, Johns Hopkins University), on a New Form of Mirror for Reflecting Telescopes.

Professor J. K. Rees (Director of the Columbia University Observatory), on the Variation of Latitude and the Reduction of the Rutherfurd Photographs.

Assistant Professor F. L. O. Wadsworth, on a Photographic Meridian Circle.

Professor E. E. Barnard (Astronomer, Yerkes Observatory), on Astronomical Photography.

Father Hagen (Director of the Georgetown College Observatory), on An Atlas of Variable Stars.

Professor G. W. Hough (Director of the Dearborn Observatory, Northwestern University), on Jovian Phenomena.

Professor G. W. Myers (Director of the Observatory, University of Illinois), on the System of β Lyræ.

Professor Simon Newcomb, on a subject to be announced later.

Professor E. C. Pickering (Director of the Harvard College Observatory), on the Work of the Harvard College Observatory.

7:30 p. m. Professor Hale will show the spectra of the following objects with the 40-inch Yerkes telescope:

N. G. C. 1976 (Orion Nebula). *α* Lyræ.
N. G. C. 7027. *α* Tauri.
Alcyone. *α* Orionis.
D.M. 30° 3639.

OCTOBER 21, THURSDAY.

8:30 a. m. Departure from Chicago, of the special train.

9:30 a. m. Final session of conferences.

Dr. Kurt Laves (the University of Chicago), on the Teaching of Theoretical Astronomy in America, and on Jacobi's Investigations in Theoretical Astronomy.

11:30 a. m. Formal Presentation and Acceptance of the Yerkes Observatory.

1. Address: 'The Importance of Astrophysical Research and the Relation of Astrophysics to other Physical Sciences.' Professor James E. Keeler, Sc.D., Director of the Allegheny Observatory.
2. Presentation. Mr. Charles T. Yerkes.
3. Acceptance on behalf of the Trustees. The President of the Board of Trustees.
4. Acceptance on behalf of the University. The President of the University.
5. Prayer. Charles Kendall Adams, President of the University of Wisconsin.

1:00 p. m. Luncheon.

2:00 to 3:30 p. m. Inspection of the Yerkes Observatory.

OCTOBER 22, FRIDAY.

10:00 a. m. Inspection of the Ryerson Physical Laboratory and other buildings of the University of Chicago.

In the Ryerson Laboratory Head Professor Michelson and Associate Professor Stratton will demonstrate the effect of a magnetic field on radiation, and exhibit an interferential comparer and a new form of harmonic analyzer.

1:00 p. m. Luncheon given by the President of the University.

3:00 p. m. Address: 'Aspects of Modern Astronomy.' Professor Simon Newcomb, LL.D.

7:30 p. m. Banquet.

THE LABORATORIES OF THE BRITISH GOVERNMENT.

THE Revenue Laboratories of the British government for chemical examination and analysis have just been housed in a new building erected adjacent to King's College Hospital. From the London *Times* we take the following facts regarding the building and its equipment: It occupies a site of about 7,900 square feet, and its various rooms, 38 in number and capable of accommodating about 100 workers, are distributed over three floors and a basement. The building externally is befittingly simple in character, and, with the exception of the entrance, which faces Clement's Inn, is altogether devoid of any attempt at ornamental treatment. On the ground floor are situated the office of the Principal Chemist, the Deputy Principal, a small reference library, the research laboratory, the crown contracts laboratories, and the laboratory for the examination of food and drugs sent by magistrates under the Adulteration Act of 1875. Samples of imported butter taken by customs officers at the port of entry at the instance of the Board of Agriculture are also examined in this laboratory, as are samples of fertilizers and feeding stuffs referred in accordance with the Act of 1893.

The first floor is wholly reserved for the examination of alcoholic products and manufactured tobacco. The alcohol laboratory, arranged for 32 workers, is a lofty, well-lighted room, with conveniently-disposed work-tables fitted with various contrivances for the rapid and accurate examination and analysis of brewing materials, worts, beers, wines, tinctures, medicated wines, compounds, etc. In the same laboratory is conducted the examination of the wood naphtha required for the methylation of alcohol. Round the room are placed the balances needed for the estimation of density, etc., and under each window is a table for the clerical work of the analysts, special arrangements being made for the keeping and preservation of the official registers. Immediately adjoining are the polariscope room and an artificially cooled chamber, capable of holding some thousands of samples pending examination. Close to the entrance of the main laboratory are the offices of the superintending analysts, each fitted with a working bench and with presses for the custody of microscopes and special apparatus. Next to these are the tobacco rooms. In one of these the incineration work, required for the determination of sand and inorganic matter, is conducted in muffle-furnaces fired by gas. The estimation of moisture in manufactured tobacco, instituted in 1887, are also conducted in this room, the samples being heated in a series of jacketed steam ovens, arranged to work continuously night and day. The main tobacco laboratory is fitted with appliances for the examination of manufactured and the so-called 'offal' tobacco for determination of drawback and for the detection of fraudulent or improper admixtures.

On the second floor are placed a number of special rooms, a museum of specimens of adulterated foods and other products, a small class-room for the instruction of supervisors, a type-writing office, and a room for the preparation of micro and other photographs.

In the basement are situated rooms for the standardization of the instruments employed in the revenue service, and laboratories for the chemical and bacteriological examination of waters sent by the Prison Department of the Home Office, the Board of Trade, Office of Works, and other public departments. There is also here provision for operations requiring a high temperature, as in furnaces, oil and air baths, etc.; a small mechanical laboratory, rooms for the storage of chemicals, apparatus and stationery, and of samples required to be

preserved either for purposes of reference or pending prosecutions.

AMERICAN MATHEMATICAL SOCIETY.

BEGINNING with the present academic year, the regular meeting of the American Mathematical Society will, as we have already noted, be held on the last Saturday of October, February and April, instead of monthly from October to May as heretofore. The annual meeting for the election of officers takes place in the last week in December, falling this year on Wednesday, December 29th. Each meeting will now extend through two sessions, beginning at 10:30 a. m. and 2.30 p. m. As a result of the arrangement, it is believed that the individual meetings will become of greater prominence and interest, and that the members of the Society will be afforded a better opportunity for mutual acquaintance and scientific discussion. The first meeting of the Society under the new program will be held on Saturday, October 30th, in Room 301 of the Physics Building of Columbia University, New York City. The following is a list of the papers thus far entered for presentation:

MORNING SESSION.

1. Dr. G. W. HILL: 'Intermediary orbits in the lunar theory.'

2. Mr. P. R. HEYL: 'Notes on the theory of light on the hypothesis of a fourth dimension.'

3. Dr. E. O. LOVETT: 'Note on the fundamental theorems of Lie's transformation groups.'

4. Professor CHARLOTTE ANGAS SCOTT:

5. Professor E. W. BROWN: 'Note on the steering of an eight-oared boat.'

AFTERNOON SESSION.

6. Professor R. S. WOODWARD: 'On the cubic equation defining the Laplacian envelope of the earth's atmosphere.'

7. ———— 'On the integration of a system of simultaneous linear differential equations.'

8. Professor MANSFIELD MERRIMAN: 'The probability of hit on a target when the probable error in aim is known; with a comparison of the probabilities of hit by the methods of independent and parallel fire from mortar batteries.'

9. Professor A. S. CHESSIN: 'Note on hyperelliptic integrals.'

DURING the past year a section of the Society has been organized with headquarters at Chicago. The meetings of the section, like the summer meeting of the Society, usually extend through two days, and are held in the Christmas holidays and in April.

THE October number of the *Bulletin* (Vol. 7, No. 1) has just been issued, and contains, beside the usual 'Notes' and 'List of New Publications,' the report by the Secretary of the Summer Meeting at Toronto, articles on 'Regular Triple System,' by Professor E. H. Moore; on 'Collimations in a Plain with Invariant Quadric or Cubic Curves,' by Professor H. S. White; on 'A generating Function for the Number of Permutations with an Assigned Number of Sequences,' by Professor Frank Morley; and a review of Koenig's 'La geometrie réglée et ses applications,' by Dr. Virgil Snyder.

GENERAL.

THE fifteenth annual Congress of the American Ornothologists' Union will meet at the American Museum of Natural History, New York, on the evening of November 8th, and will continue in session on the three following days.

THE directors of the Philadelphia museums propose holding in October of next year an exposition of the raw and manufactured products of the United States. It will be in conjunction with the next meeting of the advisory board of the museum, which will be attended by many foreign delegates.

MEMORIAL exercises in honor of the late General Francis A. Walker were held by the Massachusetts Institute of Technology, in Boston, on October 14th. There were more than 3,000 people present in Music Hall, including many delegates from educational and scientific institutions. Addresses were made by Governor Walcott and Senator Hoar.

PROFESSOR J. M. SCHAEBERLE has been appointed acting director of Lick Observatory in the place of director Edward S. Holden, whose resignation is noted elsewhere in this issue. It is said that either Professor Schaeberle or Professor Davidson will probably succeed Professor Holden in the directorship.

LORD KELVIN sailed for England on Saturday, after a week filled with engagements, including

a reception by the American Philosophical Society, a reception at Princeton and a luncheon at Columbia University.

DR. JOHN GUITERAS, of the University of Pennsylvania and the U. S. Marine Hospital Service, has returned to Philadelphia, after having made a thorough study of the yellow fever in the South, and will present an exhaustive report of his inspection to Surgeon-General Wyman.

MR. W. G. MACMILLAN, lately lecturer in Mason College, Birminghom, has been appointed Secretary of the British Institution of Electrical Engineers.

PROFESSOR GUNDELFINGER, of the Botanical Institute of Darmstadt, has been awarded the gold medal for merit of the Munich Academy of Sciences.

WE note with much regret the death of Charles E. Colby, since 1889 professor of organic chemistry in Columbia University. He was born in Lawrence, Mass., in 1855, and graduated from the School of Mines of Columbia College in 1877. Professor Colby's work was hampered by deafness and ill-health, but he was a chemist of unusual ability, and his death is a serious loss to Columbia University.

DR R. P. H. HAIDENHAIN, since 1859 professor of physiology at Breslau, died on October 13th, aged sixty-three years. He is the author of important contributions to experimental physiology, his work on secretion being perhaps the most valuable.

WE also regret to record the deaths of Dr. Edmund Drechsel, professor of medical chemistry in the University of Berne, aged fifty-six years, and of Dr. Stoll, formerly director of the Pomological Institute at Proskau, aged eighty-four years.

A DISPATCH to the daily papers stated that during an ascent of Mount Ararat, Armenia, by members of the recent Geological Congress, Dr. Stoeber, a professor of medicine, was frozen to death.

KITES sent up on October 15th, from the Blue Hill Observatory, surpassed the record of September 19th, recorded by the director, Dr. Rotch, in a recent issue of the JOURNAL, by more than 1,500 feet. They carried the meteorological instruments to a height of 10,900 feet above the hill top, or 11,500 feet above sea level. The kites were sent up at 3:50 o'clock in the afternoon and reached the highest point by six o'clock. At that altitude the temperature was 43°, while it was 73° at the ground.

DURING the course of a lecture at Montevideo, on October 15th, Dr. Sanarelli stated that the serum he has obtained from the animals with which he has been experimenting is effective against yellow fever, and that it will very probably cure yellow fever in human beings.

IT is reported that the Cavendish Sporting Expedition through Africa arrived safely at Kikuiu on August 5th, and started for Zanzibar on August 15th. The expedition has crossed from the Gulf of Aden by somewhat the same route as that of Dr. Dondaldson Smith, and is said to have made valuable geographical explorations.

IT is doubtless known to all our readers, from the daily press, that the British Foreign Office has agreed to a scientific conference on the seal fisheries by delegates from the United States, Great Britain and Canada. Professor d'Arcy Thompson will, it is reported, leave at once for the United States.

A BERLIN despatch to the New York *Sun* states that the International Leprosy Conference, which has been in session for a week, expects to conclude its deliberations on Saturday. Comparatively little has been added to the knowledge of the disease, except what was contained in a statement by Dr. Babes, of Bucharest, that leprosy bacilli were found in great abundance in mucus, which, accordingly, was a dangerous channel of infection. Another debate resulted in a concurrence of opinion that leprosy was not specifically a skin but a general disease. There was much discussion as to the treatment of the disease, especially of experiments with serum. All the experiments had been without result, except in one case, where the outcome is in doubt. The conference appointed a commission to prepare plans for the formation of an international leprosy society. Professor Virchow is the president of the commission, and Dr. Dyer, of New Orleans, is a member.

THE Audubon Monument Association of New Orleans is collecting money for a monument of Audubon to be placed in the park named after him in New Orleans. For this purpose the Association offers to sell a memorial volume giving an account of Audubon's life, prepared by Mrs. M. F. Bradford.

A CHEMICAL society has been formed at Brown University. It held its first meeting on October 5th, when an address was given by Professor John Howard Appleton on 'Recent Discoveries in Chemistry.'

FOUNDERS' Day at Lafayette College was celebrated on October 20th, the exercises being a tribute to Professor T. C. Porter, who this year retires from active service after sixty years devoted to the natural sciences, which he has taught at Lafayette College for thirty years. According to the program addresses were to have been made by Professor Nathaniel L. Britton, of Columbia University, the director of the New York Botanic Garden, on 'The Progress of Systematic Botany in North America,' by Professor William B. Scott, professor of geology in Princeton University, on 'Thirty Years of Geological Progress in North America,' and by Dr. John M. Crawford, of the class of 1871, lately Consul-General to St. Petersburg, on 'Dr. Porter as Pioneer in Finnish Literature.'

THE Commissioners of Works and Public Buildings, London, offer to distribute this autumn, among the working classes and poor inhabitants of London, the surplus bedding-out plants in Hyde and Regent's Parks and in the pleasure gardens of Hampton Court.

The Auk states that a unique and exceedingly appropriate memorial to the late Henry Davis Minot consists of a park of some fifty acres in extent, recently transferred by his four brothers, William, Charles S., Robert and Lawrence Minot, in accordance with the wishes of their father, the late William Minot, to the trustees of public reservations in Massachusetts, to be maintained as a wild park, 'for the use of the public forever.' This park, to be known as Mount Anne Park, consists of a tract of about fifty acres of beautiful woodland near the village of West Gloucester, Mass. It includes Mount Anne, or Thompson's Mountain, the highest point on the North Shore, some 225 feet above the sea—a pine-clad, granite summit in the midst of a forest wilderness. The park is otherwise charmingly diversified, being a spot of exceptional natural beauty.

THE Lowell textile school has opened its second year with an attendance of 230 students, twice as many as last year. Classes this year will be formed by Professor W. W. Crosby, of the Massachusetts Institute of Technology, Professor Fenwick, of Umpleby, and others.

MR. C. W. ANDREWS, of the British Museum, has been sent by the trustees to Christmas Island, the expenses of the expedition being defrayed by Dr. John Murray, for the purpose of making collections of the fauna for the British Museum. Christmas Island, about 200 miles south of Java, is only inhabited by some twenty-two persons, but it is soon to be used by a phosphate company, hence the importance of making collections of the fauna and flora, which are unusually interesting, a large proportion of all the species being endemic.

MESSRS. MACMILLAN & Co., Limited, have removed from their familiar building near Covent Garden to St. Martin's street, London, W. C., where they have erected a magnificent building of Portland stone, with a frontage of 106 feet in Whitcomb street, 99 feet in St. Martin's street and 24 feet in Blue Cross street. The editorial and publishing offices of *Nature* are removed to the new site, as also the British agency of SCIENCE.

THE valuable collection of vertebrata made by Mr. A. C. Savin from the forest bed, Norfolk, has been purchased by the British Museum (Natural History).

THE Sunday *Inter-Ocean*, Chicago, has published in successive issues a series of articles on the collection of fossils of Mr. W. T. E. Gurley, from 1893 to 1897 State Geologist of Illinois. In addition to tens of thousands of duplicates and unclassified specimens, the collection is said to contain over 14,000 species, all labeled and in good condition, divided about as follows: Types of batrachians and reptiles, 65; fishes (entire), 145; fish teeth, spines and bones, 765; insects and arachnids, 66; myriapods and crustaceans (exclusive of trilobites),

230; trilobites, 425; annelids, 40; rhizopods and polyzoans, 10; sponges, 60; bryozoans, 760; corals and allied forms, 1,525; lamellibranchs, 1,625; gasteropods, 1,800; cephalopods, 850; pteropods, 60; brachiopods, 3,175; cystids, 35; echinoids, 175; blastoids, 150; star fishes, 50; crinoids, 1,250 (fully 700 with heads and arms complete); hydrozoa, 90; diatoms, 25; plants, 400. The collection, as we have stated, is for sale and it is hoped that it may be secured for some institution in Illinois.

AN item in the daily papers to the effect that M. Becquerel has recently been admitted with honors to the École polytechnique, Paris, is of sufficient interest to be quoted here, in view of the fact that he is the son, grandson and great-grandson of eminent physicists. M. Henri Becquerel, his father, is the distinguished professor of physics in the École polytechnique; A. E. Becquerel, the grandfather, formerly professor of physics in the École des Arts et Metiers, is well known for his important contributions to physics, chemistry and meteorology; the great-grandfather, A. C. Becquerel, director of the Paris Museum of Natural History, was a physicist of great eminence, whose discoveries in electro-chemistry are known everywhere; an uncle, L. A. Becquerel, was also a man of science of distinction.

DR. W. F. MORSELL sends us the following further decisions of the United States Board on Geographic Names: In Kansas it should be *Junction*, not Junction City, as generally understood; so, also, in the same State, Empire City and Osage City are similarly abbreviated by the Board. A dozen or more decisions affect names in New York State, but they are unimportant. The creek, mountain and pond in Essex county is *Vanderwhacker*, not Van der Whacken, etc., and the river in the Adirondack region is *Sacundaga*, not Sacandaga, Sacondago, etc., as variously written. The channel north of Staten Island is Kill *van* Kull, not Kill *von* Kull, being of Dutch origin, not German. In Gilmer county, Georgia, there is a postoffice which the Board writes *Santaluca*. This is not from the Spanish, as one would suppose, but from the Cherokee Indian language. Among foreign names, on which there are a few decisions, the Board decides on *Austria-Hungary*, and also favors *Burma* (not Birmah nor Burmah). The German city should be *Mainz*. The German government has protested to our Consuls for spelling the word in the French way—Mayence.

THE Macmillan Company have just published the course of lectures by 'The Founders of Geology' given last winter by Sir Archibald Geikie to inaugurate the lectureship in the Johns Hopkins University founded by Mrs. Williams in memory of the late Professor Williams. In the preface to the volume Sir Archibald Geikie speaks of geological work and geological opportunity in America as follows: "Renewing old friendships with some of the veterans of the science, and forming fresh ties of sympathy with many younger workers who have come to the front in more recent years, I could not but be impressed by the extraordinary vitality which geology has now attained in the United States. Every department of the science has its enthusiastic votaries. Surveys, professorships, museums, societies, journals in almost every State, are the outward embodiment of the geological zeal that appears to animate the whole community. This remarkably rapid development of the science has not arisen from any influence derived from without, but springs, as it seems to me, from the marvellous geological riches of the American continent itself. In minerals and rocks, in stratigraphical fulness, in paleontological profusion, in physiographical illustrations, the United States have not only no need to borrow materials from Europe, but in many important respects can produce examples and materials such as cannot be equaled on this side of the Atlantic. Had the study of the earth begun in the New World instead of the Old, Geology would have unquestionably have made a more rapid advance than it has done. The future progress of the science may be expected to be largely directed and quickened by discoveries made in America, and by deductions from the clear evidence presented on that continent."

THE *American Geologist* publishes two extraordinary letters from the person who has been appointed State Geologist of Missouri. One of these letters concludes as follows:

"I will now remind you that 'every dog has his day. This is my day and the time is not far distant when your client will wish he had carried his tracks along with him. That you and he have run up against the wrong man is only a question of time. You can make the most of your opportunity and I will pursue the even tenor of my way."

Such occurrences are discouraging, even though it is certain that their duration will be but brief. We are of the opinion that it is the duty of the Geological Society of America, even though it should cost each member one-tenth of his time and of his income for one year, to see that the facts of the case are brought before the Legislature and the people of Missouri.

THE outgoing Vice-Chancellor of Cambridge University stated in a valedictory address to the members of the Senate that the gifts to the museums and laboratories during the past year include a cast of the famous specimen of *Iguanodon bernissartensis* presented by his Majesty the King of the Belgians, a refrigerating machine for experimental purposes presented by Mr. T. B. Lightfoot, a valuable collection of dried plants presented by Mrs. C. Packe, a very important library of geological books presented by Professor Wiltshire, M.A., of Trinity College, who has on previous occasions shown himself to be a most generous benefactor to the University, and two collections of great historical interest presented by the family of the late Charles Darwin.

ACCORDING to the *Statist*, the yield of gold for 1896 was about £45,000,000, against an average of £21,738,000 for the period of 1881–90. For 1896 the production by fields was as follows: United States, £10,800,000; Australasia, £8,988,000; Transvaal, £8,604,000; India, £5,911,000; Russia and other countries, £10,-697,000—or a total of £45,000,000. The grand aggregate of the gold production since 1850 inclusive is, in round figures, £1,163,000,000, or, approximately, 300,000,000 ounces of gold.

UNIVERSITY AND EDUCATIONAL NEWS.

THE Academic Freshman class at Yale University is said by the New York *Evening Post* to number 58 less than last year, while there is an increase of 15 students in the Scientific School. There is, this year, an increase of about 300 students at the University of Michigan, chiefly in the law department, and of over 100 at Columbia University. A decrease of about 50 students in the undergraduate department of Brown University is reported.

THE New York *Tribune* states that the University of Missouri receives $23,023 from the estate of the late John C. Conley, under the operation of a law recently passed by the Legislature which provides that if a man dies leaving no father, mother or direct lineal descendant a certain per cent. of his estate, excluding any amount left for charitable or religious purposes, must go to the State University.

DR. R. C. CHRISTIE, formerly professor at Owens College, Manchester, has given the College the whole of his share in the residuary estate of the late Sir Joseph Whitworth, estimated at £50,000. The College has also received gifts of £20,000 for the erection of a physical laboratory and £6,000 for its maintenance and of £1,500 towards the erection of a museum.

THOSE who last winter objected to the action of Cornell University in deciding to follow the example of the great English and other American universities and award the degrees A.B. and A.M. for scientific as well as for classical studies probably do not read this JOURNAL. Otherwise we should like to call their attention to the fact that Cornell in its short history has conferred forty-seven kinds of degrees, and ask whether it is an advantage to increase or decrease the numbers of kinds of degrees awarded for liberal studies.

THE Board of Overseers of Harvard University have concurred with the president and fellows in their votes changing the title of Hugo Münsterberg from professor of experimental psychology to professor of psychology, and of William James from professor of psychology to professor of philosophy.

DR. WILLIAM S. CARTER, of the University of Pennsylvania, has been elected professor of physiology in the University of Texas.

DR. CHARLES W. HARGITT, professor of biology in the College of Liberal Arts of Syra-

cuse University, will have charge of the work in embryology in the College of Medicine.

DR. EDWIN F. NORTHRUP has resigned from the professorship of physics in the University of Texas. The students' paper of the University remarks: "During the brief thirteen years that the University of Texas has been in operation there have been no less than five professors in this school. Their tenure of office has been short, and, in the main, their departures abrupt."

DISCUSSION AND CORRESPONDENCE.

RESIGNATION OF THE DIRECTOR OF LICK OBSERVATORY.

AFTER a continuous connection with the Lick Observatory for 23 years and a service at Mount Hamilton since 1888, I have terminated my official relations with the Observatory, to take effect on December 31, 1897. My address after October 1st will be as below:

EDWARD S. HOLDEN.

SMITHSONIAN INSTITUTION, WASHINGTON., D. C.

THE BOSTON PLANS FOR A NEW YORK BOTANICAL GARDEN.

TO THE EDITOR OF SCIENCE: I wish to call your attention to an inexcusable piece of bad taste in the last number of *Garden and Forest.* That excellent journal was from its foundation edited by the late William A. Stiles, to whom the public park system of New York is so greatly indebted. It is, however, conducted, whatever that may mean, by Professor C. S. Sargent, director of the Arnold Arboretum. The last number of *Garden and Forest*, in an editorial notice of Mr. Stiles, gives as his crowning work the following:

"It was his forethought and technical knowledge which have modified and delayed the schemes of the men who in their zeal for a botanic garden are willing to deface, unnecessarily, Bronx Park, and could his life have been prolonged this most valuable and beautiful of all the rural possessions of the city might, perhaps, have been spared for the best enjoyment of the public."

It is well known that Professor Sargent's interference with the well matured and carefully prepared plans for the New York Botanical Garden, as enlarged upon in the daily press, has lessened the public appreciation of an institution so important for the scientific and general welfare of the City. It is commonly reported here that Professor Sargent does not wish New York City to possess a botanic garden superior to the one directed by him. This report is doubtless incorrect, but it will certainly not be silenced by using an obituary notice of a friend in the manner indicated.

You will, I hope, excuse me from giving my name for publication, and will permit me to state that I am in no way connected with the New York Botanical Garden.

N. Y.

NEW YORK CITY,
October 16, 1897.

SOURCE OF THE FAMOUS THETFORD LIMBURGITE.

NEARLY half a century ago Dr. Oliver Payson Hubbard, while a member of the faculty of Dartmouth College, discovered large boulders of olivine basalt in Thetford, Vt., and discussed their probable derivation from basaltic areas in Canada.

Some of these boulders have found their way as museum curiosities to Chicago, Washington, New York and New Haven. They are particularly noted for their large rounded masses of olivine and crystalline, grayish green, glassy pyroxene.

In 1894 Dr. E. O Hovey presented to the scientific world, through the columns of the 'Transactions of the New York Academy of Sciences,' valuable information concerning the petrography of these basaltic boulders and referred them to the limburgite division of the family.

Professor J. F. Kemp has commented upon the striking resemblance of olivine diabase to these boulders, and discussed the improbability of a meteoric origin.

It has constantly been conjectured that their source was to the northward, since Vermont is in a region of extensive glaciation from that direction, yet geological research had failed to reveal their origin until last August.

During the summer of 1896, while engaged in field work in stratigraphical geology, I encountered many dikes of diabase rich in olivine, and others of the same microscopical appearance

as the typical camptonite in the Pemigewassett Valley, N. H.

By diligent investigation it was my good fortune last August to discover in the locality of these ramifying dikes and the famous Corinth copper mines an extraordinary dike of limburgite, from 6 to 10 feet in width, and penetrating the calciferous mica schist toward the west for more than half a mile.

This limburgite bears individual crystals of olivine two to three inches in length and one to two inches in breadth. A single specimen has been placed in the museum of Dartmouth College containing a crystal of olivine two and one-half inches by one and three-fourths.

Some of the smaller crystals by the oxidation of the iron have become converted into limonite or hematite; others have gone over into serpentine, while a bit of calcite derived from the contiguous orthorhombic pyroxene or the basic plagioclase feldspar is occasionally seen in the cavities once filled by the original olivine crystals.

As the locality is to the northward in the exact direction of the moving ice, and at a distance of only about twenty miles from the famous Thetford boulders, it seems evident that Corinth, Vt., was their original habitat.

C. H. Richardson.

Dartmouth College.

MORE DICTIONARY ZOOLOGY.

Some time ago I called attention in your columns to the inaccurate zoological information given by a recently published dictionary. I have just had occasion to examine the *Encyclopædic Dictionary* (Philadelphia, 1896) and should like to ask how the editors explain the following eccentricities:

(1.) *Snail.* "*H. aspera* is also eaten." *Helix aspersa* is the snail intended; *H. aspera* is a totally different snail, found in the West Indies.

(2.) *Slug.* "*A. agrestis*, the Red Slug." There is no *Arion agrestis*. The article, with its errors, appears to have been taken (without acknowledgments) from an old edition of *Chambers' Encyclopædia.* If the editors had examined the recent edition of that standard work, published several years before 1896, they would have found a different account.

(3.) *Coccus.* The species assigned to *Coccus* belong to seven perfectly distinct genera; and no author in the last twenty-five years who has given any study to these insects has used the last century classification of the *Encyclopædic Dictionary.*

The editors of dictionaries will have to realize that if their zoological definitions and articles are to be accurate and up-to-date they must employ specialists to write or revise them. Until they do so, zoologists should make it their business to call attention to the misrepresentation of their science in works which the public is asked to receive as models of accuracy.

T. D. A. Cockerell.

September 25, 1897.

LANTERN TRANSPARENCIES.

To the Editor of Science: Those who have occasion to have copies of engravings or pictures of any kind made for use with the lantern may be glad to know that such may be printed from the plates used in ordinary printing if sheets of thin transparent celluloid be taken. Gelatin also may be used. The latter is liable to roll up more or less and needs to be protected by inclosing between glass plates of the ordinary size for lantern slides. Celluloid will not trouble so much in that way, yet it is best to mount such pictures in the same way. Photographic half-tones show very well indeed, the fine meshing not being enough magnified nor dense enough to be noticed upon the screen at the distance of a few feet. Such copies need cost but a few cents apiece if the electro can be got to print from, and if celluloid be used without the glass cover perhaps one cent would be the full cost. I enclose a couple of samples that you may judge of the quality of such pictures.

A. E. Dolbear.

DANGERS OF FORMALIN.

To the Editor of Science: Now that the use of formalin for preserving objects for dissection is becoming so common, I think a word of warning as to the danger involved in the use of even attenuated solutions should be given. It is doubtless a matter for the medical faculty to

explain and limit, but as no one has spoken from their ranks a word from a layman may be of service.

The handling of objects which have been preserved in a 4 % solution kills the outer cuticle and appears to have a paralyzing effect on the sub-cuticular nerve terminations. Repeated use demoralizes the skin very badly. The vapor or minute drops arising in dissection from the objects manipulated is liable to cause serious affections of the eye. We have just heard from a recent colaborator of the museum who has narrowly escaped the loss of one eye, and is probably condemned for life to the use of glasses as a result of dissections of slugs preserved in formalin. Irritation of the mucous membrane of the air passages has probably been observed by every one who has used this preservative.

WM. H. DALL.

U. S. NATIONAL MUSEUM,
WASHINGTON, D. C., October 12, 1897.

SCIENTIFIC LITERATURE.

Hallucinations and Illusions. A Study of the Fallacies of Perception. By EDMUND PARISH. London, Walter Scott; New York, Charles Scribner's Sons, 1897. Pp. 390. Contemporary Science Series, Vol. XXXI.

The present volume is a rewriting, by the author, of his German monograph, published about three years ago; and this in turn grew out of his examination, for the Munich Psychological Association, of the cases collected in Germany for the 'International census of Waking Hallucinations in the Sane'—a project initiated and vigorously promoted by the English Society for Psychical Research. While there is an extensive literature on some one or another of the many ramifications of the general subject of illusions—particularly contributions of cases illustrative of certain special kinds or causes of illusion—there is a conspicuous lack of more comprehensive and systematic treatises covering the general field, both descriptively and with the purpose of presenting these various forms of fallacious perception from some unifying theory or principle.

It can hardly be said that the author has succeeded in filling this gap, although the road which he set out to survey has been covered with accuracy and originality. Comparison is at once suggested with the older volume of Sully on 'Illusions,' which, though far less scientifically thorough and necessarily lacking in the explanations and conceptions that have grown out of recent research, is none the less more comprehensive in scope and more philosophical as well as attractive in treatment. The general reader will still find more enlightenment as to the nature of illusions in the work of Sully than in that of Parish, although he can find no abler treatment of certain phases of this study than the latter work offers. To begin with, Dr. Parish's definition of his topic rules out the consideration of that interesting group of normal deceptions of the senses—commonly known as optical illusions and the like—which are so significant for the study of sense-interpretation and perception. Indeed, instead of conceiving an illusion as any form of psychological process which happens to be erroneous he aims to establish a type of perception, at times normal and at times abnormal, as the basis of all hallucinations and illusions. This underlying principle is found to be that of dissociation, "a state in which, indeed, generally speaking, the consciousness is normal, but where the association-paths of a more or less complicated system of elements are wholly or partially blocked." Hallucinations and illusions "are just as much sensory perceptions as the so-called 'objective' perceptions." The dream state is an extreme state of dissociation, and as such hallucinations and illusions become the stuff that dreams are made of; in insanity and nervous fatigue; in moments of emotional excitement as well as of rapt attention; under the influence of drugs and particularly in hypnotic states, the conditions are favorable for that distortion and inhibition of the normal association-paths which Dr. Parish holds to be the starting point of fallacious perception.

This conception has much in its favor; it makes it natural to find a considerable number of hallucinations among the sane and in the waking state; it certainly binds together the various forms of semi-abnormal and morbid conditions under which illusions most commonly occur; it is equally adaptable to the explana-

tion of the experimental phases of the topic, such as hypnotism, automatic writing, crystal vision ; and it further gains strength by the inherent weakness of former theories, both 'centrifugal' and 'centripetal,' which attempted to present the illusion as a reversal of the physiological process of true sensation or of some of the cortical and subcortical functions. In spite of these advantages, it cannot be claimed that this or any other theory at present serves any other purposes than that of a temporary framework for a building that is yet to be planned. The physiologist and the pathologist, as well as the alienist and psychologist, must all expend very much more planning and labor upon the foundations before a really suitable superstructure can be possible. More literally, the present status of the subject seems hardly likely to yield a true explanation of the illusory process, a satisfactory account of what really goes on in nerve and brain-cell as well as in the field of mental processes when we see with the mind's eye.

This criticism is offered in no disparagement of Dr. Parish's essay. His attempt to bring order out of chaos is most commendable, and for what is, perhaps, the most striking example of the fruitful nature of his conception the reader may be referred to is the ingenious analysis of 'audible thinking' as the analogy of 'automatic writing' which is given in Chapter VIII.

A considerable portion of the volume is devoted to the presentation of the statistics of hallucinations of the sane and their critical discussion, one phase of this discussion being devoted to those hallucinations which are supposed to be 'veridical' or to serve as proofs of 'telepathic' agencies. This portion of the work is most commendable; the sincerity and painstaking devotion of the compilers of the census and other evidence for telepathy are fully appreciated and acknowledged. But the verdict is 'not proven,' with a strong indication in favor of the negative. The extreme complexity and variety of the sources of error, the inherent defects of the logical cogency of the evidence, and the likelihood of the applicability of other and more normal forms of explanation, are all admirably set forth and together form a line of argument which the numerically strong but logically weak accumulations of cases are not likely to overcome. This careful sifting of obscure sources of error, this technical and thorough analysis of the real nature of these elusive hallucinatory conditions, makes rather difficult reading, but it is the only profitable mode of dealing with the subject.

This lack of popular attractiveness in Dr. Parish's work is probably a desirable feature, at least in some respects. The interest in this and kindred topics has been entirely too much centered upon the explanation of individual experiences and the proving of this or that hypothesis. The prevalent popular attitude is that of the man who has had an experience and wants it 'explained,' even to the most trifling detail, and who, in default of such explanation, feels warranted in disparaging the science that so dismally fails when practically tested, and in accepting any hypothesis, however unnatural or unscientific, which seems to cover his case. It is well to impress this individual with the inherent difficulty of such study, with the technical acquisitions needed to qualify one to form any opinion on the matter, and with the true statistical and impersonal method of dealing with 'cases.' The principle that in the progress of science the interest in the abnormal precedes and only slowly gives way to an interest in the normal has recently been well emphasized and illustrated ;* it is as true in psychology as in other sciences. The superficial interest in much that is 'psychic' doubtless belongs to this earlier stage of culture and will probably give way to a better comprehension and appreciation of man's normal psychology. A lesser form of utility of the present volume is in disparaging an undesirable and uncritical interest in the abnormal.

JOSEPH JASTROW.

Manual of Bacteriology. By ROBERT MUIR, M.A., M.D., F.R.C.P., Ed., Lecturer on Pathological Bacteriology, and Senior Assistant to the Professor of Pathology, University of Edinburgh; Pathologist, Edinburgh Royal Infirmary ; and JAMES RITCHIE, M.A., M.D., B.Sc., Lecturer in Pathology, University of

* By W J McGee, SCIENCE, Vol. VI., p. 413.

Oxford. With one hundred and eight illustrations. Edinburgh and London, Young J. Pentland ; New York, The Macmillan Company. 1897. Price, $3.25.

Bacteriology as a distinct domain in biology has developed with amazing rapidity within the past few years, owing partly to the stimulus which a new technique has afforded, partly to the keener appreciation of the importance in biology of a knowledge of the simpler life process down near the border line ; but more than all, perhaps, to the fact that among the bacteria are a few forms which cause a large part of the acute diseases of men and animals. For the latter reason bacteriology has been a foster child of medicine and, in the minds of many, is only one of the congeries of disciplines which we call medical science. But as our knowledge grows, we realize that the relationships of bacteriology to medicine embrace but a small part of bacteriological lore, which reaches far away from disease and deals with most significant phases of organic life throughout the earth.

In reality, the book before us is not a manual of bacteriology, but a manual dealing with those phases of bacteriology which concern disease, or medical bacteriology.

About one-fourth of the text relates to the general subject of the morphology, biology and technical methods of study of the bacteria ; a few pages are devoted to non-pathogenic microorganisms, while the remainder is given to a general consideration of the relationship of bacteria to disease, and to an epitomized description of the more important infectious diseases, especially of man. A discussion of the significant subject of immunity follows and, finally, in a series of appendices, certain of the important infectious diseases are reviewed whose etiological factors are not bacterial or are as yet unknown.

There are many manuals of medical bacteriology in many languages and of all grades of excellence, and this phase of bacteriology is growing so rapidly that new books and new editions are necessary.

This book of Muir and Ritchie is a most valuable addition to the list and might wisely supersede many of the current elementary works. It is a well-digested, well-arranged and wisely and clearly expressed epitome of the medical phases of bacteriology and of the bacteriological phases of disease. The historical glimpses of recent studies upon some of the infectious diseases aid greatly in the comprehension of the present point of view regarding them and afford clues which, in connection with the judiciously limited bibliography at the end, may lure and guide the student into a deeper acquaintance with his theme. The illustrations, over one hundred in number, are largely from photo-micrographs and the half-tone reproductions are for the most part as satisfactory as the technical limitations will permit.

The book is altogether excellent, and is really a model epitome of a difficult and complex theme, a safe and stimulating guide to the student and a boon to the busy practitioner who must read as he runs, if he reads at all.

T. M. P.

NEW BOOKS.

The Founders of Geology. SIR ARCHIBALD GEIKIE. London and New York, The Macmillan Co. 1897. Pp. x+297. $2.00.

Les ballons-sondes de Mm. Hermite et Besançon et les ascensions internationales. Paris, Gauthier-Villars et fils. 1898.

The Story of Germ Life. H. W. CONN. New York, D. Appleton & Co. Pp. 199.

Health of Body and Mind. T. W. TOPHAM. 1897. Pp. 296.

Elements of Plane and Spherical Trigonometry. EDWIN S. CRAWLEY, University of Pennsylvania. 1897. Second edition. Pp. 178.

Physical Experiments. ALFRED P. GAGE. Boston and London, Ginn & Co. 1897. Pp. ix+97.

Sixteenth Annual Report of the Bureau of American Ethnology, 1894–1895. J. W. POWELL. Washington, Government Printing Office. 1897. Pp. cxix+326.

A Correction: We have been requested to call attention to the fact that the sentence on p. 534, at the bottom of the first column of SCIENCE for October 8th last, beginning 'The Boston Trustees,' owing to an oversight was not omitted, as it should have been.

SCIENCE

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FRIDAY, OCTOBER 29, 1897.

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*SPECIAL EXPLORATIONS IN THE IMPLEMENT-BEARING DEPOSITS ON THE LALOR FARM, TRENTON, N. J.**

BY permission of Professor F. W. Putnam a number of geologists and archæologists were invited by me to conduct independent investigations on the Lalor farm in Trenton, N. J., with a view to verifying the conclusions at which he had arrived concerning the age of the artifacts found in the gravel at that place. As a result of the invitation, Mr. H. C. Mercer, Professor Arthur Hollick, Dr. H. D. Kümmel and Professor William Libbey met with me upon the ground, and we availed ourselves of the facilities afforded us by Mr. Ernest Volk, who has been for several years engaged in explorations in the vicinity of Trenton, under the direction of Professor Putnam, in the interests of the Peabody Museum, Cambridge, Mass.; the Columbian Exposition, of Chicago, and the Museum of Natural History of New York City. I was upon the ground the 25th, the 26th and the 28th of June, and September 13th and 14th, 1897. At this time Mr. Mercer was present every day but the 13th of September, and Professor Hollick every day but the 28th of June and the 14th of September, while Dr. Kümmel and Professor Libbey were present for only a single day.

* This paper will be followed by others on the same subject.—ED.

The farm on which such generous privileges have been granted by the Misses Lalor is situated on the terrace upon which the city of Trenton is built, about a mile below the city, overlooking the Delaware river from the edge of the terrace, which here descends abruptly to the flood-plain of the Delaware, about forty feet below. That this farm is within the limits of the so-called 'Trenton gravel' is conceded by every one, and is clearly evident from a gravel pit which has been recently opened not more than three hundred yards to the north. In this pit, which has been worked to a depth of about twenty feet, the general sand and gravel are very distinctly stratified, with the lines of bedding and cross-bedding perfectly distinct up to within three or four feet of the surface. Many boulders, some of them two or three feet in diameter, occur in the lower part of the deposits. A large pile of boulders which had been thrown aside by the workmen well illustrates the observation early made by Professor Cook and Professor Shaler, that the material of the Trenton gravel is almost entirely derived from the upper part of the valley of the Delaware river, and is to that extent local material.

There is but one theory entertained by geologists at the present time concerning this gravel, which is, that it is a delta deposit made by the glacial floods which came down the river from the melting of the ice which formed the Belvidere terminal moraine, about seventy miles above Trenton. Through that distance the gradient of the river is about three and a-half feet to the mile, and the valley is narrow, so that the abundant floods of that time could easily bring down the excessive amount of *dêbris* released by the melting ice. On reaching tide-water and a broader valley at Trenton the swollen streams of that epoch rapidly built up the fifty-foot delta terrace upon which the city stands. This terrace is from two to three miles in diameter, upon the New Jersey side, and wherever excavated shows substantially the same phenomena described in the pit adjoining the Lalor farm, which is about the middle of the special enlargement of the deposit from north to south from which the gravel received its name.

The excavations made by our party were upon the summit of this delta deposit, beginning from the bluff where it faces the river valley to the west, and which breaks down to the level of the flood-plain, forty feet below, with as steep a descent as the gravel would naturally maintain, the slope being now covered with a luxuriant growth of forest trees.

As our investigations were made with reference to verifying the conclusions of Mr. Ernest Volk, it is proper to state the main results of his work. Mr. Volk has carefully dug over the area stretching back from this bluff for a width of about three hundred feet and a length of something like twenty-five hundred feet. Over all this area he has sunk trenches a little over three feet in depth, and carefully noted the evidences of human occupation, together with the character of the deposit and the depth at which the artificial objects have occurred. All this material gathered by him is to be found carefully labelled, but for the most part unreported upon, in the museums above referred to in our first paragraph. Mr. Volk's work has shown that the upper twelve inches of this surface contains more or less signs of vegetable mould, and a very large number of chips and chipped implements made from flint and jasper, with occasional chipped pieces of argillite. Many other indications of the ordinary occupation by Indians also occur in this upper foot of soil; such as pieces of pottery, the bones of animals which had been used for food, and pieces of charcoal. Occasionally, also, there are pits running to a depth of two or

three feet in which are similar objects down to the bottom.

But in the compact undisturbed sand from one foot below the surface through the two feet or more of the lower part of the trenches Mr. Volk reports that he has found no pottery or charcoal or chipped fragments of jasper, flint or quartz; but that he has found, sparingly scattered throughout the entire mass, many chipped fragments and implements made from argillite, these occurring frequently near the bottom of the trenches, three feet and more below the present surface and two or more feet below ordinary signs of recent disturbance.

At the first visit our own work consisted in the digging of one long trench from near the edge of the bluff back through a distance of twenty-one and a-half feet. Its width was three and three-quarters feet, and its depth a little over three feet. This was immediately north of the ground which has been explored by Mr. Volk. We also dug three other pits, one being about twenty feet farther north, which was $7\frac{3}{4}$ x $4\frac{1}{2}$ feet; another, thirty feet east of the second, which was six feet square; a fourth, one hundred feet still farther east, and on ground about one foot higher, which was four and a-half feet square.

After careful examination we fixed upon fifteen inches as the limit of probable or possible ordinary disturbance, and had all the superincumbent soil removed from the trenches to that depth. We then had narrow excavations made two feet lower or to a total depth of forty inches, in some cases going still farther down. Having prepared a smooth perpendicular surface, the work was subsequently done by carefully scraping off the face of the excavation with a trowel, and when any object of stone was encountered, all were called to witness it in place before removal. In this way a total amount of three hundred and twenty-five cubic feet of the deposit was carefully examined. This is equivalent to a trench forty feet long, four feet wide and two feet deep; this being the lower two or more feet of the material removed.

Number of Objects Found.—As a result of this examination during the first visit, there were found in the lower two feet of undisturbed soil fifteen chipped fragments or implements of argillite all covered with a deep patina, two thick flakes of jasper and three of quartz, with a few broken stones. There were found and counted also between three hundred and four hundred pebbles ranging from the largest, which was $8\frac{1}{2}$ x $4\frac{3}{4}$ x $2\frac{1}{2}$ inches, down to numerous ones the size of a French pea. Many of them were from one to two inches in diameter. The implements were scattered pretty evenly through the entire mass of gravel. The upper five inches contained four; the second five, seven; the third five, four; the fourth five, five. Besides this there were six battered or broken pebbles, showing artificial origin, but all these were in the upper six inches of our stratum. Of the quartz and flint flakes, two were found in the upper four inches, two from ten to twelve inches down, and one at a depth of eighteen inches.

The Character of the Strata.—Beginning at the top, there is first a stratum of fifteen inches to be excluded. The upper seven inches of the stratum under consideration consists of compact sand in which there are no signs of bedding or disturbance of any sort.

Below this occurs, over most of the area, a reddish, clayey band, about a-half inch thick, which extends in a wavy line, often thinning out so as to be almost imperceptible.

Below this is a stratum of yellowish sand, similar to the first, about six inches thick.

Below this is a second continuous reddish band slightly waved, but far less so than

No. 1, and about two inches thick, thinning out, however, in places to half an inch or slightly less.

Then occurs another stratum of yellowish sand, about four inches thick.

Still lower comes reddish clay,* ten inches thick, partly divided by an irregular stratum of sand, two or three inches thick, running through the middle of it. In some places, however, the clay bands coalesce, and the sand continues along the line in lenticular masses. This clay stratum rests upon the more completely washed sand and gravels which form the great mass of the terrace.

Analysis of these Strata.—The predominant material in the entire thickness examined is sand, but there is mixed with it a varying amount of clay and iron, both being specially concentrated in the red bands. I have had specimens from these strata analyzed to determine the relative amount of clay, sand and iron contained in them. The specimens were first thoroughly and repeatedly soaked and shaken in water, which was poured off immediately, carrying everything which could be held in suspension, and leaving the sand thoroughly washed. After being allowed to settle twenty-four hours, the water was siphoned off and the residue thoroughly dried. This was then compared in bulk with the residue of sand which had also been dried. All the specimens were treated in a similar manner. The results were, beginning at the top:

1st sand stratum, 18% suspended matter; 2d sand, 16%; 3d sand, 14%; underlying sand, 7%. Of the red bands, 1st red stratum, 24% suspended matter; 2d red stratum, 27%; 3d stratum, 27%; 4th (or lower part of 3d) stratum, 37%. The amount of iron contained in the fine sediments so far as analyzed was as follows: from the 2d sand, one-half of one per cent. of the whole amount; of the 2d red stratum, one and one-half per cent. of the whole amount, and the same for the 4th red stratum. These red bands, therefore, are not to any appreciable extent segregations of iron. The iron scarcely more than suffices to give the color. The analysis shows, therefore, that these red bands contain from 25% to 33% more clay than is found in the interstratified strata of sand.

While the water-worn pebbles were distributed more or less through the entire mass, they are specially abundant in and below the second, third and fourth reddish clayey accumulations. These pebbles vary in size, as has been said, from those several inches in diameter down to small pieces of gravel. Pebbles from one to two inches are numerous. The largest one referred to was imbedded in the clayey stratum, No. 2, just as if dropped into the clay and pressed nearly through it, crowding lower down two or three smaller ones which underlay it. This was found in the longer trench, thirty-two inches below the surface, or seventeen inches below our selected zone of doubt. This was about three feet distant from the locality of one of our best-formed chipped argillite scrapers, which occurred three inches lower down in the deposit, and beneath the clayey stratum. As I personally removed with my trowel all material in this section, I know that the clayey stratum containing the large pebble was continuous and unbroken, not only between the pebble and the point directly over the argillite implement, but for two or three feet upon the other side, and that pebbles, large and small, were frequently struck by the trowel along the entire distance.

The implement above referred to was located carefully and photographed by us. The first clayey band over it was here about two inches thick and so compact as to give distinct special resistance to the trowel

* Throughout I use clay as signifying simply sediment so fine that it is held in suspension in water for an appreciable time.

wherever it was struck. Its level was twenty inches below our zone of doubt, or thirty-five inches below the surface. Upon our last visit, however, two well-formed argillite implements were found at still greater depth, and if possible in still more unequivocal position. One of these, found by Professor Hollick, was in the main trench more than twenty feet farther east. This was, also, below the second clayey band, which is here nearly ten inches thick. The implement was three feet five inches below the surface, or twenty-six inches below the arbitrary line we had fixed as our zone of doubt. The order of strata was as follows: one foot, disturbed soil; eighteen inches, compact yellow sand; first wavy reddish clayey band, one-half inch; yellow sand, two inches; second reddish clayey stratum, with inclosed lenticular sand patches, ten inches; sandy layer, five inches, containing the implement; reddish clayey band, five inches. Below this, without any signs of unconformity, were several successive alternating strata of sand and reddish clayey material to the total depth dug, six feet nine inches. There was every indication that the entire deposit up at least to the upper wavy reddish clayey stratum was built up by a continuous process of water deposition, the upper portion representing the waning cycles of deposition characteristic of floods which were reaching their limit both by reason of increased elevation of the flood-plain and of a diminution of the water supply.

Eight feet north of this implement, across the end of the trench, with the strata continuous between, Mr. Volk had previously photographed another argillite implement in place one inch lower than this and beneath almost exactly the same succession of strata. Again, on the face of one of our earlier pits farthest from the bank, about forty feet disant from this one, we found on the second visit and photographed, and Mr. Mercer took out with his own hands, a well-formed argillite implement three feet three inches below the surface, or two feet below our arbitrarily chosen line of doubt. There were two of the clayey bands above this, the order being closely similar to that described in the trench. The second of the clayey bands, which is here about two inches thick, contained a pebble more than two inches in diameter, which was pressed down into the stratum as if by its own and the superincumberent weight. On removing the pebble the clay adhered to it, but was not cemented to it. It could all easily be removed with the fingers. Two or three feet east of this implement were the marks of the tap-root of a tree which had penetrated all the strata to a depth of something over two feet. It was perfectly easy to distinguish the course of this root, but there were no other signs of such disturbance around the face of the exposure in the vicinity of any of the implements described.

Extent of the Reddish Clayey Bands.—To determine the extent of these deposits and the manner of their formation, pits were dug at three points, from two hundred to five hundred feet farther in from the edge of the bluff. Two of these were upon a slightly elevated ridge, from two to three feet higher than our main trench, being the highest portion of the plain. The other was in the center of a shallow basin, towards which there was a gradual slope in every direction, it being from two to three feet lower than the trench and about two hundred feet away. In all these pits the succession of strata was similar to those in the main trench, with this difference, however, that the reddish clayey bands were encountered several inches lower down in the center of the basinlike depression than upon the higher elevations. This effectually disposes of the theory that the slight irregularities in the surface were produced by wind action. If the elevations were wind accu-

mulations the sand would be thicker there than in the depressions, but the opposite was the case. The slight irregularities of the surface, therefore, are the result of original motor deposition and not of wind action.

Observations upon other portions of the delta terrace revealed the same condition of things. In the gravel pit already referred to, about three hundred yards to the north, the succession in the upper three or four feet exposed is substantially the same. The clayey bands are distinctly apparent, and the whole structure is conformable. In this pit there occurs, and was photographed by us, a thick deposit of fine sand near the bottom, containing thin wavy bands of stratified clay, very similar to the upper one described in our main trench. Again, about a mile distant, toward the southeast, near the park, an excellent exposure of the terrace shows the same succession. With this, also, agrees the description given by Mr. Volk of his explorations on the same terrace in 1891, at a point about half way between the park and the present explorations. (See Proceedings of the A. A. A. S., Vol. XLII., 1894.) In describing the strata, he says: "The soil in this place consists of nine inches of black or subsoil, tilled land, overlying an undisturbed sandy loam composed of quartz sand, colored by iron and mixed with a yellow soil, the sediment of muddy water, the whole having a light yellow color. Three feet below the surface is a somewhat uneven stratum of red clay mixed with sand."

From all this it is clear that this deposit, up at any rate to the upper line of reddish clayey band, is part and parcel of the Trenton gravel.

A most natural explanation of the deposition of these successive strata of sand and clayey bands is at hand in the closing floods of the glacial period which confessedly built up the terrace to within a few inches of several of the implements found in place. All the phenomena can easily be accounted for by the forces then known to be in operation. The floods accompanying the close of that stage of the glacial period which formed the terminal moraine crossing the river at Belvidere brought down the *débris* from the melting ice until the delta terrace was built up to a height of about forty-seven feet. This, all readily admit. But it is easy to see that as the delta grew higher, and the material accessible to floods diminished, the closing deposits would consist of finer material, the conditions being somewhat like those of ordinary flood-plains, only in this case the forces were more extraordinarily variable and vast in their proportions. In the last stages of this epoch we may well suppose that during the months of July, August and September the waters running over this delta terrace were occasionally swollen enormously, though the elevation overflowed was such that any large masses of boulder-laden ice were prevented from sweeping over it, such as did during the earlier stages of the deposit. These floods would easily distribute large quantities of sand along the edge of the terrace of the main stream, extending back for an indefinite distance or to the slightly higher deposits that had previously been made, and this under conditions so uniform that several inches might be accumulated without signs of bedding. On the subsidence of the floods the clayey strata would naturally accumulate, as shown in these deposits.

But how did the implements become incorporated in the strata? By a process which is perfectly natural and credible. During the larger part of the year, when the melting of the glacial ice was proceeding at a slow rate, vast bars and abandoned channels of the main pebbly deposits of sand and gravel would be exposed, affording to the aboriginal inhabitants a choice

field for procuring argillite boulders, with an occasional one of quartz or jasper, from which to make their favorite implements; while the conditions connected with the head of tide-water doubtless made it then, as later, a favorite hunting and fishing ground. Few things have ever impressed me so much as the abundance of life of all sorts at the head of the inlets, both in Alaska and Greenland, into which large glaciers pour their currents of ice-cold water. The implements and chips lost by the natives on these temporarily abandoned stretches of gravel and sand bordering the main current are the ones mingled with scattering pebbles which were swept into their present position upon the Lalor farm by the subsequent floods of the season.

But this condition of things did not remain long. After the flooded Delaware ceased to receive superabundant glacial *dêbris* and an excessive supply of water from the melting ice it not only ceased to build up the terrace, but began speedily to cut and enlarge its present channel, leaving the surface of the delta terrace forever after undisturbed by its action. The terrace is now about forty feet above the flood-plain. Thus we have a natural and perfectly credible method for accounting for the phenomena in question.

It is, however, not only incumbent to provide an adequate cause for such phenomena, but we are in duty bound to give sound reasons for excluding other hypotheses which may be supposed to account for the facts. One hypothesis is that the clay band No. 2 has been produced by segregation, and so may have been formed over the implements found underneath it since their deposition. But the stratum contains only a slight amount of iron in excess of that found throughout the entire sand deposit. There still remains the excessive amount of clay which characterizes the stratum. It can scarcely be possible that that was segregated over so extensive an area after the whole had been deposited. Besides there must be something to account for the slight excess of iron which characterizes the red stratum. It is not only slightly excessive in amount above what is found in the accompanying sand, but is different in color; that being yellow and this red.

The suggestion that this clayey stratum No. 2 is an old wind-blown surface encounters several insuperable objections.

1. Its extent and uniformity are greater than could be obtained by a wind accumulation.

2. It contains large numbers of pebbles too great for removal by winds. As already mentioned, one of these was several inches in its longest diameter, and many were over an inch in diameter. To the suggestion that these may have been brought upon the surface by human agencies at the same time that the chipped flakes were lost, it can be answered that many of these were too small to have offered any inducement to anybody to have brought them up into that place, and they are scattered through the formation so uniformly that they indicate distribution by natural agencies; while their occurrence in the clayey stratum points to water, and not to wind, for their distribution. Especially significant were the two or three small pebbles underneath the large one which lay as if pressed by the weight of the larger pebble into and almost through the clayey stratum.

To the suggestion that these pebbles had been brought up from the lower strata by overturning of trees, it is to be said that if that was the case it must have been before the formation of the clayey stratum since that by actual observation was continuous and undisturbed for a distance of many feet on either side of many of these pebbles.

To the theory which would account for the iron in the stratum through the oxida-

tion of the vegetable accumulation occurring upon the surface, it is to be replied that this would not account for the accumulation of clay, but rather it needs the accumulation of clay to arrest the soluble iron in its downward progress. Whatever may be true of that upper and more wavy film of reddish material, it cannot well be maintained that stratum No. 2 is of a different origin from that of the thicker strata 3 and 4, the last of which rests directly on the acknowledged glacial gravel. In case of these it cannot be maintained that they are the results of a progressive oxidation proceeding from the surface downwards, since they are distinctly separated by the strata of yellow sand. There must have been something in the original deposition to have determined the relation of these differently colored strata to each other, and that original stratification has not been to any great extent disturbed by subsequent agencies.

If these red bands are the results of oxidizing agencies connected with vegetable deposits, they must still be placed long anterior to the accumulation of vegetable mould which is now upon the surface; for in many cases Indian pits are found in which the vegetable mould is entirely unaffected by oxidizing agencies; and, as this farm is known to have been occupied by the whites two hundred years, we have a partial measure of the slowness with which vegetable matter decomposes in this soil.

Furthermore, if the action of tree roots, worms and other small animals were so great in breaking up and destroying the lines of stratification two or three feet below the surface, as some have supposed, these clayey strata must be very recent, else they would have been completely obliterated. But their integrity is a complete answer to the theory that the soil down to a depth of four feet is everywhere necessarily disturbed through the lapse of long periods of time. In the present case every attempt to account for the clayey strata 2, 3 and 4 otherwise than by the agency of water is beset with insuperable difficulties. There are none of the marks of those other supposed agencies left to indicate their activity. Whereas, with the acknowledged floods of water rising to within a few inches of these deposits, it is easy to believe in the extension of this agency in building up the deposits of the superincumbent fifteen inches. If any one denies this natural and easy explanation he is bound to bring forth reasonable evidence to the contrary. To adduce complicated hypotheses involving inadequate and unknown causes of which there are no signs present, is not sufficient.

The evidence that the implements found below stratum No. 2, forty-one inches below the present surface, and only five inches above the action of acknowledged glacial floods, belong to the deposits of the glacial floods is sufficient, I believe, to convince any one who comprehends all the facts. At any rate, it is in the highest degree hazardous to assert that the problem of their age is insoluble, and that no trustworthy inference concerning it is possible. For a short time the facts can remain open for the observation of others. Let any one who is in doubt visit the locality and see for himself.

Professor Libbey of Princeton University spent the afternoon of September 14th with us on the ground when all the exposures were open to inspection. These he photographed and carefully examined with reference to all the questions involved. In respect to them he writes as follows: "Princeton, September 20, 1897. I take pleasure in putting on record my opinion with reference to the deposits which we studied together last week. There is no doubt in my mind as to the origin of the deposits in which the various implements were found. The lower gravel layer immediately below is undoubtedly due to

water action, and I cannot believe that the banded region composed of sand heavily mixed with clay could have been laid down in any other way than those just below. Certainly no wind action can ever be held responsible for such level and uniform deposits over such an area, but it might rather be explained by a change in level affecting the velocity of the current—in fact, I believe the existence of this bed can be explained only in this way."

G. FREDERICK WRIGHT.

OBERLIN, September 20, 1897.

PROFESSOR RUDOLPH HEIDENHAIN.

THE announcement of the death of Professor Rudolph Heidenhain, though not entirely unexpected, will call forth in physiological circles a note of deepest regret. It brings to memory the names of Brücke, Helmholtz, Karl Ludwig and Emil DuBois-Reymond, members of that coterie of brilliant scientists whose unusual ability for many years attracted to the German laboratories students of medicine from every part of the civilized world. And with these names are largely associated the remarkable transformation and progress which physiological science has experienced since the days of Johannes Müller.

Rudolph Peter Heinrich Heidenhain was sixty-three years of age at the time of his death, having been born Marienwerder, January 29, 1834. The elder Heidenhain was a physician, and it was not strange that the young man should inherit an enthusiasm for the natural sciences; it is told, in fact, that his interest in the work to which his life was devoted was early aroused by the reading of Volkmann's 'Haemodynamik,' which had just been added to the father's library. Heidenhain pursued the usual university medical studies at Königsberg, Halle and Berlin, receiving his degree at the latter place in 1854 with a dissertation entitled 'De nervis organisque centralibus cordis cordiumque ranae lympaticorum.' As assistant to Du-Bois-Reymond, the following three years were devoted to investigations in muscle physiology, a series of studies being published in 1856. In 1857 Heidenhain qualified at Halle as 'Privatdocent' in physiology, with a thesis entitled 'Disquisitiones criticae et experimentae de sanguinis quantitate in mammalium corporis exstantis'; two years afterward, in 1859, at the early age of twenty-five, he accepted the chair of physiology and histology at Breslau in Silesia, a position which he occupied until his death. Heidenhain obtained many official distinctions during his academic career, and among these the Harveian medal with which he seemed especially pleased; he was a member of numerous learned societies, and for many years enjoyed the title of 'Geheimer Medicinalrat.'

The advent of Heidenhain to Breslau and to the institution in which, years before, Purkinje had been active, was followed by a series of physiological researches continued almost uninterruptedly until the past year. These contributions have been marked not alone by the originality with which the subjects have been treated, but especially by a deep insight into the problems presented and a thoroughness of investigation and devotion of energy as untiring as it was characteristic. The results of these labors have had so important an influence in determining certain chapters of physiology as taught to-day that it may, perhaps, be permitted to present a few fragments of Heidenhain's work and to indicate their bearing.

In 1864 appeared the well known monograph on 'Mechanische Leistung, Wärmeentwickelung und Stoffumsatz bei der Muskelthätigkeit.' Helmholtz had shown that the tetanic contractions of a muscle, when continued for some minutes, are attended by a production of heat, but it re-

mained for Heidenhain to demonstrate a rise of temperature amounting to 0.003–0.005°C. with each individual contraction. He discovered the fact that the amount of heat evolved by a muscle in contraction increases with its tension; and in the demonstration that a muscle which contracts without doing external work gives off more heat than does the working muscle on contraction, the principle of the conservation of energy was illustrated by a significant experiment.

To the student of physiology the muscle studies briefly referred to may seem to bear little, if any, relation to Heidenhain's later investigations on the secretory processes in the organism. There was, however, a single great problem which gave the impetus to most of the physiologist's work. "I have endeavored all my life," he once remarked to the writer, "to learn something of the processes which go on in the living cells of the body. In my earlier studies I selected the muscle cells because of their large size. But I soon found that I could not reach the desired end by this means and accordingly I turned to the secreting glands, where I might better observe the entire cells under the microscope. Thus I have been carried farther and farther." Heidenhain's researches on the secretory processes have become classic, and his masterly volume on 'Absonderungsvorgänge' published in 1883 in Hermann's Handbuch der Physiologie will remain as a permanent contribution to physiological literature. The experimental researches which form the basis for these chapters, and in which Heidenhain enjoyed the assistance of a considerable number of co-workers in his laboratory, appeared in large part in the Studien aus dem physiolog. Institut zu Breslau, I.–IV., 1861–1868; in Pflüger's Archiv für Physiologie, and in Schultze's Archiv für Mikroskopische Anatomie.

The tendency of physiolological research at about the middle of the century had been in the direction of a distinctly mechanical theory of the secretory processes in which the physical forces resulting in filtration and diffusion were called upon to explain the known phenomena. The prevalent impression was in good measure due to the brilliant teachings of men like Brücke and Ludwig, although even the latter appreciated many of the difficulties which this aspect presented. It was left for Heidenhain to emphasize the inadequacy of any universal application of the current principles of physics and chemistry to satisfy the problems presented in the secretory functions. He insisted, first of all, on enquiring into the specific changes which take place in the individual organs incidental to their activity; and here again we discover the fundamental notion which was the key-note to Heidenhain's work, namely, the desire to investigate the ultimate seat of physiological changes, as he expressed it: "Das Wesen der lebenden Zelle die überall in ursprünglich einfacher oder differenzirter Gestalt die Vermittlerin und Trägerin des Geschehens ist."* In expanding these ideas Heidenhain has been occasionally misunstood, or unjustly accused of a belief in some 'vital' forces which transcend the possibilities of natural science. Indeed, I cannot refrain from referring to this fact, which always aroused regret in him; for to one who is familiar with his work nothing can seem more unjustified than this suspicion. No scientist of to-day will deny that the processes which go on in the living cells, that diffusion through a living membrane, is quite a different thing from the processes which can be provoked in these same elements after their death. This, however, does not imply the existence of other forces than the chemical and physical ones which continually manifest themselves in the inorganic world. It merely

*Hermann's Handbuch der Physiologie, V., 11.

indicates that our knowledge of how these forces are exerted and how the energy of the cell is transformed is hypothetical or wanting; and not until this deficiency is made up can the physiological experiment be interpreted in simple physico-chemical terms. This was Heidenhain's teaching.

The study of the secretion of the bile early claimed the attention of Heidenhain and his pupils. Besides contributing valuable data on the composition of this fluid and the conditions modifying its discharge from the liver, he made comparative measurements of the pressure under which the bile is secreted and the pressure in a branch of the superior mesenteric vein. In finding the bile pressure invariably twice as high as the blood pressure in the portal vein, he demonstrated for the bile, as Karl Ludwig had done in 1858 for the saliva, that secretion is not a mere act of filtration and thus a mechanical result of blood pressure.

The year 1866 marked the beginning of a series of papers which have contributed more than all others to bring renown to the Breslau physiologist and which mark a distinct advance in physiological knowledge. I refer to the brilliant researches on the salivary, gastric, pancreatic and other glands, in which physiological experiment was successfully combined with histological investigation. The facts discovered have been verified by numerous observers and are familiar to every biologist. Here was shown for the first time that in the secreting glands structural changes go on hand in hand with functional processes. With characteristic patience and thoroughness the various glands were made the subject of an exhaustive study and each new field afforded new problems and new results. For the salivary glands it was shown that the production of specific constituents and the secretion of water are more or less independent processes and thus the idea of distinct trophic and secretory nerves was introduced into physiology. For the pancreas, too, Heidenhain indicated indirectly the existence of specific secretory fibres, which Pawlow has since directly proved. The distinction between serous and mucous glands was also pointed out on the basis of structural, chemical and functional differences.

In his studies on gastric and pancreatic secretion Heidenhain pursued with success the plan which had been found valuable in the case of the salivary glands, and we owe our knowledge of the minute structure of these organs during rest and activity in large part to the labors of this investigator. The fundus and pyloric fistulæ are examples of the valuable methods of research developed by him. Almost simultaneously with Rollet he announced the distinction between the central and parietal gastric cells; his discovery, in 1875, of the so-called 'zymogen' of the proteolytic enzyme of the pancreas has been followed by announcements of precursors for other ferments and has added a new idea to the theory of secretion.

Contrary to the older theory of Bowman, Ludwig had taught that the urine is excreted entirely through the epithelium of the Malpighian capsule, the fluid being eliminated in consequence of purely mechanical filtration, and undergoing a subsequent concentration by the diffusion of water into the lymph spaces surrounding the kidney tubules. Heidenhain's experiments first demonstrated conclusively that the epithelial cells of these tubules take a prominent part in renal secretion. He did not fail to note, at the same time, the close dependence of secretory activity upon blood flow, *i. e.*, upon material for cellular work and upon the presence of oxygen; thus was emphasized the teleological significance of Claude Bernard's discovery that the blood vessels of secreting glands are greatly dilated during glandular activity.

The researches to which the later years of Heidenhain's life were devoted followed

in the course prepared for them by the earlier investigations. In several comprehensive and valuable papers on the histology and physiology of the intestine the inadequacy of osmotic forces to accomplish the work of absorption under many conditions is experimentally shown, the methods of the newer physical chemistry being drawn upon to yield results in a new field. Simple physical forces were supplemented by 'physiological' processes and the seat of these was assigned to the living epithelial cells. The researches on the formation of lymph which have appeared from the Breslau institute in recent years have opened up a broad field of inquiry that, together with the problems of absorption and transudation, is interesting physiologists to-day as perhaps few other themes are. Nowhere in Heidenhain's hypotheses have simple physical factors been excluded; but the difficulty or inadequacy of the latter in accounting for all the facts known is made apparent. And remembering the many differences of opinion that have arisen, let me quote the words of Professor Michael Foster: "In the controversy thus arisen, the last word has, perhaps, not yet been said, but whether we tend at present to side with Heidenhain, who has continued into the past thirteen years the brilliant labours which were, perhaps, the distinguishing features of physiological progress in preceding periods * * * or whether we are inclined to join those who hold different views, we may all agree in saying that we have, in 1897, distinctly clearer ideas of why secretion gathers in an alveolus or lymph in a lymph space than we had in 1884.'*

The preceding must suffice in this place to indicate some of the advances which physiology owes to Heidenhain. If to these is added the mention of his researches on the tonic contractions of sphincter muscles, on the heart and the nervous system, on hypnotism, etc., one cannot fail to be impressed by the broadness of the man. As a scientific writer his style is interesting and convincingly logical. His two monographs in defence of vivisection* have been widely circulated. As a teacher Heidenhain enjoyed unusual success. His lectures were remarkable for the lucid treatment of every department of physiology and histology, and few physiologists, I venture to add, were so liberal in their demonstrations. With every chapter at once made historical as well as critical, and giving evidence of a very wide acquaintance at first hands with the literature of the subject, these lectures would form an admirable text-book with which few of those now used on the Continent could favorably compare. The modest equipment of the old laboratory formed a striking contrast to the splendid results it yielded at the hands of a master.

Heidenhain's home life was charming and the reception within the family circle always cordial. To one associated with him in his work, nothing was more impressive than the man's intense devotion to his science. The indifferent student could expect little sympathy from Heidenhain; but no attention was spared, no effort too great in behalf of the individuals who won favor in the Breslau institute. Logical argument and unbiased observation characterized Heidenhain's presence in the laboratory. His thoughts continually wandered into the realm of unanswered problems, and more than once in recent years did he express the regret that the days still left must be brief, at most, for the tasks awaiting completion. These fruitful labors have, indeed, been ended too soon.

LAFAYETTE B. MENDEL.

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* Address to the Physiological Section, British Association for the Advancement of Science, Toronto, 1897.

* 'Die Vivisection im Dienste der Heilkunde,' 1879, and 'Die Vivisection,' 1884.

PHYSICS AT THE DETROIT MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SECTION B of the American Association for the Advancement of Science met with Professor Carl Barus in the chair and Professor Frederick Bedell as Secretary. 'Long Range Temperature and Pressure Variables in Physics' was the subject of Professor Barus's vice-presidential address, which has been published in full in SCIENCE. It was very interesting and was very well received. The address dealt with the historical development of pyrometry and piezometry, with a view to the present state of progress in these subjects, and with especial reference to their application to problems on the physics of the earth's crust.

The first paper on the list was by Professor F. P. Whitman and Miss Mary C. Noyes on the effect of heat on the elastic limit of copper wire. Their work was a continuation of a research on the effect of heat on Young's modulus (published in the *Physical Review*, Vol. II., p. 277). The yield-point was found to increase as the wires were stretched, heated and cooled. From a long series of tests made on the same wire it appeared that the wire was approaching a permanent condition. If the wire was heated to a red heat, or if it was stretched considerably beyond its elastic limit at the start, it maintained a nearly constant state afterwards. There were curves shown which graphically represented the changes in the behavior of the wire.

Professor A. L. Foley next read a paper on 'Arc Spectra.' He examined the light coming from the arc and found that it was due to concentric layers of different color. He used a concave grating to throw the spectra of different parts of the arc upon photographic plates. The outer layer was found to be strongest in the yellow. The upper carbon, whether positive or negative, was covered to a greater depth with the yellow flame. Inside the yellow was a blue area stronger at the positive carbon, and inside the blue and at the positive carbon violet was found.

Mr. Chas. F. Brush read a notable paper on the transmission of radiant heat by gases at varying pressures. Before describing his own investigations he referred briefly to those of Dulong and Petit, who used a large copper 'balloon,' about three decimeters in diameter, coated with lamp-black on the inside, in the center of which the thermometer bulb was placed. In discussing the cooling of bodies *in vacuo* Dulong and Petit fell into the grave error of deducing the behavior of the last few millimeters of gas from that of the rest. In this way they arrived at their 'Sixth Law:' The cooling power of a fluid diminishes in a geometrical progression when its tension itself diminishes in a geometrical progression. If the ratio of this second progression is 2, that of the first is 1.366 for air, etc. Mr. Brush said that his own observations show that this law can be approximately true only in the case of a large balloon, and at pressures from a few millimeters upward; that there is no suggestion of it where a small balloon is used, and at small pressures it does not obtain with either large or small balloons; he found that in a small balloon the cooling effect of the last millimeter of air is nearly ten times as great as that of all the rest, up to atmospheric pressure, combined. It was through misplaced confidence that Dulong and Petit were led to place a value on the rate of cooling *in vacuo*, something like a hundred per cent. too high; and as they derived the cooling values of gases by deducting the cooling effect of a vacuum from the total, all their values for gases are much too low. This error vitiates much of their other work. Mr. Brush carried his observations down to those made at one-twentieth of a millionth

of an atmosphere and found that the rate of cooling did not break down materially even then. To measure pressures he constructed two McLeod gauges. These gauges and their use Mr. Brush described in another paper on the measurements of small gaseous pressures. He gave, as an example of the delicacy with which small pressures were measured, the measurement of about two millionths of atmospheric pressure, with a probable error of only one part in three thousand of the quantity measured. From this he concluded that, with the apparatus described, small gaseous pressures might be easily measured with a probable error of less than a thousandth part of the millionth of an atmosphere. Mr. Brush showed many figures and curves to illustrate his work.

Professor W. A. Rogers read a paper on a final determination of the relative lengths of the imperial yard of Great Britain and the meter of the archives.

Professor Nichols read Mr. S. G. Barnett's paper on the influence of time and temperature upon the absolute rigidity of quartz fibres. Mr. Barnett found no time effect even after three months and an exceedingly small positive temperature coefficient of about three ten-millionths.

The discharge of electrified bodies by X-rays, by Dr. C. D. Child, was a subject which has been interesting scientific circles of late. The air, and in fact almost every gas, is an excellent insulator under ordinary conditions; but when acted upon by X-rays it becomes for the time a conductor. The resistance offered to the passage of electricity under these circumstances depends upon the pressure, temperature and kind of gas, as well as upon other more obscure causes. Dr. Child's paper deals especially with the influence of the *pressure* of the gas. He finds that, when the pressure of the air is increased from a few millimeters of mercury up to atmospheric pressure, the rate at which electricity can be conducted by the air in general increases to a maximum and then decreases again. The pressure at which the conductivity of the air is greatest depends upon the E. M. F. tending to send current through it. If the E. M. F. is high the pressure for maximum conductivity seems to be greatly in excess of atmospheric pressure and lies beyond the range of Dr. Child's measurements.

In addition to a careful study of the effect of pressure upon the phenomena, Dr. Child has also investigated several other points, some of which have heretofore been in dispute. For instance, he finds that electricity can be continuously discharged from a charged body under the influence of X-rays, even when the body is covered with a *solid* insulator, such as a thin layer of paraffin. This result agrees with the observations of Professor J. J. Thomson and contradicts in part the conclusions of Lord Kelvin. Dr. Child has also studied the effect of X-rays developed by an induction coil when the rate of interruption is varied. Many parts of Dr. Child's work which cannot even be referred to here will go far toward explaining the irregular and contradictory results which most observers in this line have heretofore obtained.

Professor F. P. Whitman described some investigations which he had made on the brightness of pigmented surfaces under various sources of illumination. The colors of the surfaces were ten in number, ranging through the spectrum. The flicker photometer was used for the comparisons, and some very interesting information was obtained.

Professor H. S. Carhart read a paper on the design, construction and test of a 1,250 watt transformer which had been made under his directions by two of his students. The core type was chosen instead of the shell, for reasons of convenience, as the iron for the core could be cut at the tinsmith's without a die. From the data obtained in

its test it appeared that the transformer agreed in resistance, regulation and efficiency almost exactly with the values computed in advance. The fall in E. M. F. between no load and full load was 2.3 per cent., and the efficiency at full load was 95.4 per cent. This paper is published in the *Electrical World* for September 18, 1897. Dr. Karl E. Guthe described some experiments on the electrolytic action of condensers. He used commercial condensers, and found polarization and recovery much as in an electrolytic cell. He showed several curves illustrating the results obtained. The graphical treatment of alternating currents in branch circuits in cases of variable frequency, by Professor H. T. Eddy, was a very full exposition of the subject. Many diagrams were shown, in which a whole series of assumptions as to the capacity and self-induction gave a corresponding series of curves. It would not be possible to give a proper notice of Professor Eddy's paper without reproducing many of his diagrams.

Professor Alexander Macfarlane read an instructive paper on simple non-alternating currents. Professor A. G. Greenhill, of Woolwich, England, exhibited stereoscopic views of spherical catanaries and gyroscopic curves which were very interesting. The mathematics of each curve were given on the back of the card on which the stereoscopic projections of the curve were drawn. Professor Ernest Merritt read Dr. L. A. Bauer's paper on the magnetic survey of Maryland.

Professors G. S. Moler and Frederick Bedell exhibited apparatus adapted to determining the frequency of an alternating current. The instruments here included are two in number. The first one, which has already been described by George S. Moler (*Physical Review*, March–April, 1897), consists of a small synchronous motor brought to speed by a crank handle connected with the motor by a suitable train of gears. The apparatus contains an electrically operated speed counter, so arranged that its reading gives the exact value of the frequency of the alternating current with which the synchronous motor is supplied. The whole apparatus does not weigh over nine pounds. The reading is correct to within .05 of an alternation. The second instrument consists of a sonometer or monochord. The alternating current flows through a piano wire mounted upon a sounding board. The wire passes between the poles of a permanent magnet. By means of a sliding bridge the period of the wire may be made equal to that of the alternating current. This is indicated by the vibration of the wire. A scale is arranged so that the position of the bridge indicates the frequency directly.

Dr. W. J. Humphreys gave an interesting account of some experiments on the effect of pressure on the wave-lengths of the lines of the emission spectra of the elements. He found a shift of the lines toward the red about proportional to the pressure and to the wave-length. The shift appeared to be independent of the temperature. Professor C. L. Norton described a new form of coal calorimeter. An abstract of his paper is in the *Electrical Engineer* of September 9, 1897. The coal is burned with oxygen inside the calorimeter in a platinum crucible, on a very thin dish of platinum perforated with a large number of holes near the edge. The lightness and good conducting power of the platinum crucible and plate assure their being at a high temperature during combustion, and to this is due the completeness of combustion. No trace of carbon monoxide and no indication of soot is to be found in the resulting gases. Professor E. B. Rosa read Dr. F. A. Laws' paper on a new form of harmonic analyzer. An electrodynamometer was used. A current sinusoidal in character, and of frequency vari-

able in multiples of the main current, was sent through the fixed coil, and the main current through the other coil. The deflection of the electro-dynamometer gave means of computing the magnitude and phase of the different components.

Very interesting papers were read by Dr. N. E. Dorsey, on the determination of surface tension of water and of certain aqueous solutions by the method of ripples; by Professor Frank E. Bigelow, on the series of international cloud observations made by the United States Weather Bureau; by Professor C. F. Marvin, on kites and their use by the Weather Bureau in the exploration of the upper air, and by Mr. B. B. Brackett, on the effects of tension and quality of the metal upon the changes in length produced in iron wire by magnetization.

Professors E. W. Morley and D. C. Miller presented a joint paper on the coefficient of expansion of certain gases. As the coefficient of expansion of hydrogen has been determined by the International Bureau of Weights and Measures at Paris, with a very high degree of precision, that of other gases may be determined by comparison. The method used in these experiments is a differential one, in which the difference in the expansion of oxygen and hydrogen, for example, can be determined with accuracy. Hydrogen is placed in one globe of five liters capacity and oxygen in a similar globe. These globes are connected to a manometer. They are first surrounded with melting ice, and then with steam. The differential expansions are readily observed. In this way the coefficients of expansion of four gases have so far been determined as follows:

Carbon Dioxide	0.0037122
Nitrogen	0.0036718
Air	0.0036719
Oxygen	0.0036729

A Note on the Construction of a Sensitive Radiometer was read by Professor Ernst Fox Nichols. In this paper the construction of a new form of compensating torsion radiometer, used recently in a number of researches in the remote infra-red spectrum, was described in detail. The instrument is capable of a higher degree of sensitiveness than either the spectro-bolometer or linear thermopile. A steadiness of action and freedom from extraneous disturbances, when working at high sensitiveness, are secured by means of the compensating action of two precisely equal vanes symmetrically mounted on either side of the axis of a quartz fibre suspension. The system, in consequence, is acted upon differentially by all accidental disturbances, while rays to be measured are concentrated upon one of the vanes. The degree of sensitiveness actually attained in one instance was so great that the influence of rays from a single candle at a distance of one-third of a mile could be detected and roughly measured. With an instrument of this kind Professors Rubens and Nichols have recently discovered heat waves one-fortieth millimeter in length, and have demonstrated their electro-magnetic character.

Professors E. L. Nichols and E. Merritt presented a paper on the photograph of manometric flames. The photographs were taken on a revolving drum of sensitized film, and showed in a striking way the effects of various sounds. Words and short phrases were spoken before the receiver. It was of interest to note that the effects of nearly like sounds could be distinguished in the photographs. The paper was illustrated with many lantern slides.

Professor Carl Barus read papers on the rate at which hot glass absorbs superheated water, and on a method of obtaining capillary canals of specified diameters. In the former he computed from experiment that there is an absorption per hour of 0.025 $\overline{\text{cm.}}^3$ of liquid water per $\overline{\text{cm.}}^2$ of glass sur-

face at 180°C. The importance of the observed increase in compressibility and in volume contraction in the lapse of time was especially dwelt upon. In the latter paper he said that elastic tubing punctured with 5,000 to 10,000 extremely small holes was subjected to external and internal pressure. The mean diameter of the pores in any given case is computed from the pressure-difference just necessary to cause a flow of gas against the capillary reaction of the wet porous septum. The author points out various applications of such tubes. Among other points, the cyclic character of the flows of liquid through the pores, when pressure increases and decreases consecutively, is exhibited.

Professor Frederick Bedell read a paper written by himself, Professor R. E. Chandler and Mr. R. H. Sherwood, Jr., on the predetermination of transformer regulation. To determine the regulation by this method a wattmeter, ammeter and voltmeter are located in the primary circuit. One set of readings is taken with the secondary short-circuited by a stout copper wire, the primary voltage being adjusted until the normal full-load current or any desired fraction of it flows in the transformer. No other data for obtaining a complete regulation curve is required except the one set of readings above mentioned and the magnetizing current. If a wattmeter reading is taken when the magnetizing current is measured, the data is sufficient to plot a complete efficiency curve as well as a curve for the regulation of the transformer. The two sets of measurements then consist of the reading of a wattmeter, voltmeter and ammeter, first on short-circuit with normal current, and second on open-circuit at normal voltage. The wattmeter reading in the first case gives the copper losses; in the second case, the core losses. It is commonly convenient to use the high-potential coil as primary in the short-circuit measurements, and the low-potential coil as primary in the open-circuit measurements. A high-potential supply is not then needed, and as no power is required except to supply the losses, the complete test of a transformer may be made with an incandescent lighting circuit for the source of supply, a 50 light transformer being tested from one 16 c. p. lamp socket. The total drop is found by laying off in the proper manner the inductive drop, the magnetic leakage drop and the drop due to ohmic resistance. The method is theoretically an almost exact one. Practically it is an exact method and less likely to error than the ordinary method of determining the regulation of a transformer by loading it. The results given in this paper (given in full in *The Electrical World*), from a long series of tests on seven transformers of various makes, shows the reliability of the method, the secondary voltage at full load determined by it varying usually less than one or two-tenths of a volt from the voltage as found by measurement on the transformer when actually loaded. An approximate method (by Kapp) used by one of our large electrical companies gives less accurate results. The reader is referred to the data given in the full paper.

An electrical thermostat, by Dr. W. R. Whitney, consisted of mercury in a U tube. One arm of the tube contained ether, and the other air, at reduced pressure. One platinum wire was fused into the bottom of the tube and another above the mercury in the leg of the tube containing the ether. On the rise of the temperature the ether gas expanded much more rapidly than the air and forced down the mercury below the ether; a control electrical circuit through the platinum wires and the mercury is thus broken, and through it the heating circuit. Professor W. O. Atwater and E. B. Rosa described their apparatus for testing the law of conservation of energy

in the human body. The subject was confined in a room whose walls consisted of a layer of copper, outside of which were one layer of zinc and three layers of wood, with air spaces between. The temperature of the air spaces was kept the same as that of the inclosed room, by means of currents of air. The condition of uniformity of temperature was tested by many thermo-electric junctions in series, which were distributed over the surface as uniformly as possible. The average position of the galvanometer mirror was kept zero. A deflection of one millimeter on the scale corresponded to one one-hundredth of a degree Centigrade. The amount of heat evolved in the room was calculated from the corresponding mass and change of temperature of the air which was forced to enter and leave the room through pipes. Frequent analyses of the air were made to determine carbon-dioxide and water vapor. The average of the results indicated that the law of conservation of energy was true.

Professor E. B. Rosa read a paper by himself and Mr. A. W. Smith, on electrical resonance and dielectric hysteresis. The dielectric experimented on was used in the form of a condenser, which was placed in an electric circuit, in series with a coil whose self-inductance was just sufficient to bring the alternating current used into phase with the E. M. F. The power expended in the circuit was made up of two parts, one proportional to the resistance of the coil, and the other proportional to the equivalent resistance of the condenser. These quantities multiplied by the square of the current (virtual) gave the power expended.

Dr. Margaret E. Maltby presented an interesting paper on a method for the determination of the period of electrical oscillations and some applications of the same, which was based upon a new application of the Wheatstone bridge principle. The two halves of the measuring instrument—an electrometer—serve as two arms of the bridge, and the other two contain a condenser joined to the electrometer needle and the two pairs of quadrants respectively. The relation that exists between these two, when there is no deflection, is a function of the rate of alternations in the current that passes through the system, viz: $T = \pi CR$, when T is the period of a single alternation, C the capacity and R the resistance. If C is known in electrostatic units and R in electromagnetic units, C/v^2 should be substituted for C above, and it is then possible to solve for v. Other applications of the method are evident. See Wiedemann's Annalen, B. 61, H. 3, S. 553.

In a joint session of Sections A and B Professor G. W. Patterson, Jr., read a paper on the electro-static capacity of a two-wire cable, in which he deduced the formula

$$C = \frac{0.01206\,K}{\log \dfrac{\sqrt{4RD + D^2} + D}{\sqrt{4RD + D^2} - D}},$$

when C is the capacity in microfarads per kilometer, K the dielectric constant of the medium, R the radius of each conductor and D the least distance between them. Common logarithms are used. Professor W. F. Durand explained an approximate method of treating differential equations, in which he integrated by summing up areas considered as trapezoids. By making the intervals small enough any degree of accuracy might be obtained. Professor Alexander Macfarlane explained a new method of solving certain differential equations that occur in mathematical physics. The method was applied to equations whose solutions involved exponential and sine functions. Mr. C. P. Steinmetz was on the program to read a paper on the screening effect of induced currents in solid magnetic bodies in an alternating field; but, much to

the regret of the Section, he was unable to be present.

GEORGE W. PATTERSON, JR.
UNIVERSITY OF MICHIGAN.

*A NEW METHOD OF SYNCHRONIZING STRATA.**

FOR nearly a century it has taxed stratigraphical geologists to the utmost to devise some rational and practical method by which the strata of the globe, the exposed sections of which are not visibly connected, can be brought into synchronous juxtaposition. Various schemes have from time to time been proposed, tried and abandoned. While it is a simple matter to correlate two rock outcrops which are not far away from each other, the difficulties rapidly increase with distance and by existing standards the determination of the exact equivalents finally become almost impossible.

It is the special province of geological correlation to establish a general chronologic sequence for rock successions more or less widely separated geographically. The main features of some of the more important standards of comparison that have been adopted or are being used may be briefly considered, their scope defined and their limitations noted. These methods fall into two main categories: (1) the strictly physical, and (2) the biological. Of these the latter have, for many years, been most widely followed. At the present time the former are beginning to assume much greater prominence than ever before.

So profound an influence have the organic remains entombed in the rocks had on correlation problems that it has only been very recently that the inherent weaknesses of this criterion has begun to be appreciated. The advantage of the physical method over the biological is indicated by the remark made lately by McGee that "Nearly as much information concerning the geological history of the Atlantic slope has been obtained from the topographic configuration of the region within two years as was gathered from the sediments of the coastal plain and their contained fossils in two generations."

Indeed, for more than a score of years that branch of geology called stratigraphy has been practically at a standstill. Its methods are the same that were used 50 to 75 years ago. However, the science of geology as a whole has made gigantic strides. Within the last two decades several entirely new branches have sprung into existence. New and refined methods of working have been formulated. With all this activity going on about it, stratigraphy itself has been at last provided with new weapons of offense and defence, and is beginning to experience a revival that is surely destined to restore its old time prestige.

The scope of the purely physical criteria of correlation and of geological classification as set forth in late years appears to have been generally overlooked. Attention needs to be called only to a few of these. Irving and Van Hise have formulated admirable methods of correlation, in which organic remains are left entirely out of consideration. McGee and his colleagues have, by purely physical methods, attacked the unfossiliferous deposits of the coastal plain and then have applied the same methods successfully to the fossiliferous terranes. Davis and others have rejuvenated the old methods of stratigraphical continuity and lithological similarity, by making possible a system of correlation by geographic forms, and broad areas are now being geologically mapped by this method alone. All of these methods are more or less complex and not simple, but they demonstrate that newer and more natural ways are rapidly replac-

* Abstracted from a paper read before the Academy of Sciences of St. Louis.

ing the older and more artificial ones, and that there is ample hope for devising physical means of correlation that are more in harmony with the real nature of the problems involved.

Still more recently it has been suggested that the real basis of geological correlation should be found in the causes giving rise to and governing sedimentation. This involves primarily a classification founded upon mountain-making movements. It is proposed, therefore, to emphasize this factor as fundamental in the marking off of the leading subdivisions of geological time, and to define general stratigraphical succession in accordance with the cycles of orogenic development, calling the classification or fundamental principle of correlation a systematic arrangement by mountains, or orotaxis. It is believed to overcome many of the difficulties that are usually encountered in correlation, in that it enables successions of strata to be paralleled not only in provinces whose geological history has been similar, but in those in which it has been very different.

Charles R. Keyes.

CURRENT NOTES ON PHYSIOGRAPHY.

THE ROCKY MOUNTAIN FRONT.

Monograph XXVII., U. S. G. S., on the Geology of the Denver Basin in Colorado, by Emmons, Eldredge and Cross, gives some account of physiographic features amid its detailed description of geological structures. The mountain front, when seen from a distance, rises as if from the sea in a continuous but rugged slope. A closer examination shows that, after reaching a certain height, the frontal spurs ascend more gradually to the main crest of the range, which lies unexpectedly far back. The upper valleys are wide open, but descend into deep and narrow gorges towards the 'shore line.' This is taken to indicate a revival of stream action by uplift, after an advanced stage of denudation had been reached when the region stood at a lower level. The hog-back ridge of the upturned foot-hill strata (Dakota), with the longitudinal subsequent valleys behind it, is generally even and continuous. Zigzag turns are formed on occasional folds; lapses of the ridge are noted at Golden and Boulder, where the Dakota sandstone was not deposited. The moderate relief of the Plains is shown to result from extensive denudation; the uppermost members of the series are broadly stripped off, leaving wide valleys between uplands and mesas of significant relief to the cross country traveller, but broadly plain in comparison to the bold mountain front.

CASTLE MOUNTAIN, MONTANA.

Castle Mountain is an outlying member of the Front range of the Rocky mountains in Montana, between the Missouri and Yellowstone rivers. It is described by Weed and Pirsson (Bull. 139, U. S. G. S.) as a 'dissected volcano,' although the considerable cone that must have once risen here (as attested by lava flows and tuffs) has been almost completely denuded, and the existing mountain of massive granite is hypothetically represented as of laccolitic structure in the corrugated beds of the heavy stratified series; the granites being older than the effusive materials. As is so generally the case in the Rocky mountains, moderate deformation occurred after extensive denudation of the corrugated strata, and considerable stratified deposits now mark the sites of lakes thus formed; the plains of Lake Smith, west of Castle Mountain, being the local illustration of this geographical element. The volcanic eruptions were antecedent to the lacustrine period, as the lake beds consist largely of stratified volcanic tuffs. Glacial action is indicated by well marked moraines which are referred to two epochs.

The description of the lake beds above mentioned suggests a recurrence to a note in a recent number of SCIENCE. The lower beds, 200 feet of well-indurated clays, are covered with sandstones and conglomerates, 'much cross-bedded and greatly resembling the Pliocene lake beds so common in the mountain valleys of Montana.' The upper beds range from marls to conglomerates, varying rapidly in kind and composition. Is it not probable that these variable upper beds are largely of fluviatile origin?

SCENERY OF YELLOWSTONE PARK.

'SOME geological causes of the scenery of Yellowstone National Park' are discussed by A. R. Crook (Amer. Geol. XX., 1897, 159–167), but with inadequate attention to the action of ordinary erosive processes. Mention is briefly made of the uplift of various mountains, but their extensive denudation into existing forms is hardly referred to, except under the head of glacial action, which is given an excessive value. The extreme youth of the Yellowstone Canyon in contrast to the maturely sculptured valleys of its headwaters, one of the most striking features of the Park, finds no mention. Although punctuated here and there by geyser basins and surrounded by a frame of bold mountains, the monotony of the scenery over large rhyolite areas will disappoint many visitors who read exclamatory descriptions of this 'Wonderland of America.' The bicycle as a means of travel in the Park deserves notice to intending visitors of the hardier kind.

THE PHLEGRÆAN FIELDS.

THE Oxford University Geographical Studentship, held in 1895–96 by R. T. Günther, leads to an essay under the above title as the result of extended field work (London Geogr. Journ., X., 1897, 412–435). The area studied lies west of Naples—a region of 'crater-like hills and hollows, volcanic ridges and trachytic rocks,' known as the *Campi flegræi*, or Burning fields. It is associated with level stretches of fertile volcanic soil, spread by water or other agency and known as the *Campagna felice*. Volcanic activity, as a cause of topographic features, has here been manifested in a slow outwelling of fluid materials, forming heaps or streams of lava; or in explosive discharges, forming craters surrounded by circular ringwalls of débris. The older volcanoes are much altered by stream and marine erosion, as well as by later volcanic action. Twenty-six craters more or less completely preserved are described and classified according to relative age. The later craters are smaller and nearer the shore than the older ones.

In view of the well-determined occurrence of calderas, as a result of destructive volcanic action in contrast to the constructive action that produces typical craters, it is to be regretted that no consideration is given to the differences between these two serviceable types of volcanic forms.

W. M. DAVIS.

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CURRENT NOTES ON ANTHROPOLOGY.

THE PRESENT POSITION OF ETHNOGRAPHY.

THERE has lately been published, from the pen of Dr. Andrew Lincke, an interesting survey of the present position and recent contributions to the science of ethnography. Although his main attention is directed to the area of Germany, and particularly Saxony, he has also made an examination of what has lately been done for Asia and other parts of the world. His pamphlet of ninety-two pages is much more than a catalogue of books and papers. He undertakes to assign their respective value to those which he has himself read, and, although his notices are necessarily brief, they will be found useful indications to the reader and student. Dr. Lincke is himself well

known as a writer on folk-lore, and to this branch he devotes considerable attention in his essay. He does not concede much space to American writers or subjects, but for this omission the explanation in the preface relating to the difficulties of exhausting so wide a field is sufficient.

His paper, entitled 'Ueber den gegenwärtigen Stand der Volkskunde,' is published by the *Verein für Erdkunde,* in Dresden, and presumably may be obtained from it.

THE END OF THE HUMAN RACE.

ONE of his learned and thoughtful articles is contributed on this subject by the Marquis de Nadaillac in a recent number of the *Correspondant.* Making anew the calculation of the increase of population as compared with the increase of the food supply, he reaches the gloomy conclusion that in a few centuries there will inevitably be too little food to supply all the mouths. He compares the statistics of most civilized nations, and they appear to confirm his apprehensions. For instance, Russia alone, at its present rate of births, will in one hundred years be obliged to feed eight hundred million persons! What, he asks, can stem this overwhelming tide of population? He gives up the problem, and says that we must leave it to God, a solution which is more creditable to his piety than to his position as a scientist. The real solution is to educate men and women to the point where they will not recklessly produce offspring; nor yet ruthlessly prevent them, as is the case now in some departments of France, where the population is actually diminishing, although the wealth is above the average.

Unfortunately, modern prejudice stands in the way of a fair and full discussion of this solution.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

THE *Berichte* for September 27th contains a description by Emerich Szarvasy, of Budapest, of two new salts formed by the action of carbon dioxide and of sulfur dioxide on a solution of magnesium methylate. The first compound is a methyl-magnesium carbonate $(CH_3)_2Mg(CO_3)_2$ and may be looked upon as a methyl salt of magnesium bicarbonate, but unlike the latter, which decomposes on evaporating its solution, the methyl salt is comparatively stable, and its solution in methyl alcohol can be boiled without decomposition. If sulfur dioxid is used in the place of carbon dioxid the methyl magnesium sulfite is formed, which is also stable. The compounds may also be looked upon as magnesium salts of methyl-carbonic acid and methyl-sulfurous acid, and show the great resemblance in many respects existing between the carbonates and sulfites.

THE chemical world has great occasion to deplore the untimely end of Victor Meyer, and many lines of investigation begun by him, but not completed at the time of his death, will doubtless be for the present abandoned, while others may be carried on by his pupils and assistants, but will suffer for the lack of his guiding hand. One of his great works was the determination of vapor density at high temperatures, and while he had worked as high as 1,500°, and, perhaps, a little higher, he had entered upon investigations which would enable him to work above 2,000°. The most difficult part of the problem is to get a vessel to contain the gas, which will stand the temperature and at the same time be gas-tight. The first steps in this work are described in the last *Berichte.* The only material found which would satisfactorily withstand the heat of the furnace used, which was fired by a graphite burning in a stream of oxygen, was magnesia. This did not fuse, but when pure was very porous. A nat-

ural magnesia from the magnesite of Veitsch containing some ten per cent. of impurity, chiefly iron with silica, was found to sinter together in the heat of the graphite furnace and form gas-tight vessels. As the hottest zone of the furnace is very restricted, it was found possible to fire successfully only very small vessels in this manner. Attempts were made to fire larger density tubes in a oxyhydrogen furnace, but at the highest heat obtained the magnesia was still porous. Efforts to glaze the tubes also all resulted in failure. Here this exceedingly difficult investigation now stands, and it is to be hoped that Professor Meyer's assistant, Dr. Bodenstein, who, with Dr. von Recklinghausen, has carried it thus far, will go on with it to success. The value of density determinations at a high temperature is of great importance to chemical theory, and Victor Meyer's work has already afforded very valuable results, but if 500° more could be gained the value would be much increased.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE German Society of Men of Science and Physicians will hold its meeting next year at Dusseldorf, under the presidency of Professor Waldeyer, of Berlin. The secretaries of the meeting are Professor Mooren and Dr. von Viehoff, of Dusseldorf.

PROFESSOR A. A. MICHELSON, of the University of Chicago, has been made a member of the International Committee of Weights and Measures in the room of the late Dr. B. A. Gould.

WE called attention last week to the fifteenth Congress of the American Ornithologists' Union. The meetings at the American Museum of Natural History, for the presentation of scientific papers, beginning at 11 a. m. on Tuesday, November 9th, are open to the public and should prove of interest to many residents of New York. Information regarding the Congress can be had by addressing the Secretary, Mr. John H. Sage, Portland, Conn.

DR. FRIDJOF NANSEN arrived at New York on October 23d, and was in the evening the guest of the American Geographical Society, which conferred upon him the Cullum Geographical Medal and elected him an honorary member. Another reception was given to him on Monday night by the Swedish and Norwegian inhabitants of the city. A reception and dinner was offered him by the National Geographical Society, Washington, on October 26th. To-day the American Philosophical Society of Philadelphia will hold a special meeting, at which Dr. Nansen will present a paper on 'Some of the Scientific Results of Recent Arctic Explorations.' Dr. Nansen's first public lecture will be given at the Metropolitan Opera House, New York, on November 6th.

MR. E. E. HOWELL, of Washington, has just received from the U. S. Government Board of Control an order to construct a relief map of the Yellowstone National Park, for exhibition at the coming exposition at Omaha. This model, which will be 6 x 6½ feet in dimensions, will be based upon the surveys of the Park made by the U. S. Geological Survey and will represent the geology as well as the topography. The scale will be one inch to the mile, and there will be no vertical exaggeration. The map will be very accurate and complete, far surpassing the one made some years ago.

THE U. S. Geological Survey has practically completed the distribution of the Educational Series of Rocks, 175 suites of 156 specimens each having been sent out during the past summer to universities, colleges and technical institutions in the United States. There remains a small number of incomplete sets, which will be placed in such smaller colleges as will make them most useful. The Educational Series were prepared by the Survey with much care, for the purpose of aiding students in acquiring a general and special knowledge of rocks and promoting the study of geology.

THE first meeting of the new session of the Royal Geographical Society will be held on Monday, November 8th. After a short introductory address by the President, Sir Clements Markham, K. C. B., Mr. F. J. Jackson will give an account of the Jackson-Harmsworth expedi-

tion to Franz Josef Land, of which he was leader. At the second meeting Dr. Sven Hedin will describe the results of his four years' explorations in Central Asia. Lieutenant Peary has promised to go to England about the end of November, and it is to be hoped that he will appear before the Society early in December. Other papers which may be expected are by Sir W. Martin Conway, on his recent expedition to Spitzbergen; by Mr. E. A. Fitsgerald, on his explorations on and around Mount Aconcagua; Mr. Warington Smyth, on the Eastern Malay Provinces of Siam, and Dr. John Murray, F. R. S., on his recent investigations in the Scottish lakes. There will be a special meeting early in 1898 in connection with the 400th anniversary of the discovery of the Cape route to India by Vasco da Gama. Special afternoon meetings are being arranged for and Christmas lectures to young people. Under the auspices of the Society and the London University Extension a series of twenty-five educational lectures is being given in Gresham College by Mr. H. J. Mackinder, M.A., on the geography of Great Britain and the British seas.

THE principal medal of the Royal Photographic Society, London, has been awarded to Professor Gabriel Lippmann, Paris, for his work in color photography by the interference method.

WE regret to record the deaths of Dr. Justin Winsor, Librarian of Harvard University and President of the American Library Association, on October 21st, aged sixty-six years; of Professor John Foster, emeritus professor of natural philosophy in Union College, with the faculty of which he had been connected since 1836, aged eighty-three years; of Mr. E. P. Franz, formerly assistant to Professor Schaeffer at University College, London, in conjunction with whom he carried out important researches in neurology; and of Mr. William Scott, a well-known horticulturist and arboriculturist, director of the Royal Gardens and forests, Mauritius, at Stirling on the 3rd of October, aged thirty-eight years. He was home on leave after an unbroken residence in the tropics extending to sixteen years.

WE take from the *British Medical Journal* the following details regarding the late Professor Charles Smart Roy, whose death we were recently compelled to record. Born at Arbroath, Scotland, in 1854, he enjoyed a thorough education in training and research at St. Andrew's, in London and in Germany. Appointed George Henry Lewes student in 1880, he came to Cambridge and worked at the pathology of the heart, spleen and kidneys in Dr. Michael Foster's laboratory, where he gave a course of lectures on physiology to advanced students. On the election of Dr. Greenfield to the chair of general pathology in the University of Edinburgh, Dr. Roy was chosen to succeed him as Director of the Brown Institution. During the tenure of this office he visited the Argentine Republic for the purpose of investigating the causes of an epizoötic disease then raging among cattle in the Province of Entre Rios. He held the directorship for two years and a-half, when in 1884 he was elected to the newly-established professorship of pathology in the University of Cambridge. At first the teaching of pathology was carried on in rooms belonging to the Physiological Laboratory, but in 1889 the old chemical laboratory was transformed and refitted to accommodate the department of pathology. In this building, with the help of such able students as Griffiths, Hankin, Adami, Hunter, Wesbrook, Kanthack, Lorrain-Smith, Lloyd Jones, Cobbett and others, much brilliant work in pathology and bacteriology has been carried on under Professor Roy's direction. He invented many ingenious pieces of apparatus for physiological purposes, some of which, such as the oncometer and oncograph and the tonimeter, are universally known among investigators, and will continue to be called by his name. His researches on the heart, carried out with Professor Adami and independently, have thrown new light on that perplexing organ; it is, perhaps, on these that his reputation will chiefly rest.

A COMMITTEE has been appointed at the Johns Hopkins University to arrange and execute a memorial to Professor J. E. Humphrey and Dr. F. S. Conant, who died from pernicious malarial fever, contracted at Port Antonio, Jamaica, where they were conducting the Marine Laboratory of the Johns Hopkins University.

Dr. H. L. Clark, also of the expedition, nearly lost his life from the same disease.

The *Associazione Elletrotecnica Italiana* has appointed the following foreign committee to receive subscriptions to the fund which is being collected for the erection of a monument at Turin in memory of the late Galileo Ferraris: Rudolph Alioth, Professor E. Arnold, Dr. A. D'Arsonval, Professor W. E. Ayrton, Dr. Frederick Bedell, Otto T. Blàthy, Professor A. Blondel, C. S. Bradley, C. E. L. Brown, Professor Dr. Emil Budde, Dr. Coleman Sellers, M. Alfred Cornu, H. Cuénod, Max Déri, E. Desroziers, Dolivo Dobrowolsky, Dr. Louis Duncan, Thomas A. Edison, Edmunds Henry, Professor Jas. A. Ewing, Professor J. A. Fleming, Hippolyte Fontaine, Professor Geo. Forbes, Dr. O. Frölich, Professor Eric Gerard, Ernest Gerard, H. Görges, Eugen Hartmann, F. V. Hefner-Alteneck, Professor H. Hering, Dr. John Hopkinson, Professor Eduard Hospitalier, E. Hüber, J. Joubart, Gisbert Kapp, J. Kareis, Lord Kelvin, Professor Dr. Erasmus Kittler, Dr. Friedr. Kohlrausch, W. John Lieb, Jr., W. H. Lindley, Professor G. Lippmann, Dr. L. Lombardi, Professor E. Mascart, Senat. Montefiore, W. M. Mordey, Alois Naville, Professor Oliver Lodge, Dr. A. Palaz, R. V. Picou, W. H. Preece, Pantaleoni, Emil Rathenau, C. W. Rechniewski, Professor E. Rousseau, Professor Henry Rowland, Alexander Siemens, Dr. A. Slaby, Charles P. Steinmetz, Dr. Gotthold Stern, Professor G. Peter Tait, Nikola Tesla, Professor Elihu Thomson, Professor J. J. Thomson, Professor Sylvanus P. Thompson, Rene Thury, Th. Turettini, Friedrich Uppenborn, Dr. A. von Waltenhofen, Dr. H. F. Weber, Edward Weston, Joseph Wetzler, Dr. V. Wietlisbach, Professor W. Wyssling, Professor Carl Zipernowsky. The American Association for the Advancement of Science, at the Detroit meeting, authorized Dr. Frederick Bedell to collect subscriptions from the members of the Association.

The Indian government has asked for twelve medical men to be sent out from England to the Bombay Presidency for duty in the plague-stricken districts.

The Linnæan Society of New South Wales, Sydney, desire applications for the position of Macleary bacteriologist, the salary of which is about $2,000 per annum.

The late Edward C. R. Walker has bequeathed $20,000 to the Massachusetts Horticultural Society, to be known as the Samuel Walker Fund. The bequest is subject to several life interests.

The Staff of the North Carolina Agricultural Experiment Station has been reorganized as follows: Alex. Q. Holladay, Chairman of Council; W. A. Withers, Chemist and Acting Director; Frank E. Emery, Agriculturist; W. F. Massey, Horticulturist, Botanist and Entomologist; F. E. Hege, Poultry Manager; B. S. Skinner, Superintendent of Farm; A. Rhodes and C. W. Hyans, Assistants in Horticulture, Botany and Entomology; J. A. Bizzell, C. B. Williams, H. K. Miller, C. D. Harris, A. W. Blair, J. D. Hufham, Jr., and F. G. Kelley, Assistants in Chemistry.

At a recent meeting of the New York Zoological Society the executive committee reported that the plans for the zoological park are practically complete, and that it is imperative that the remainder of the first $100,000 of the building fund should be subscribed at once in order that the plans may be submitted to the Park Board without delay. If the needed sum is subscribed the completed plans will be laid before the Park Board at its meeting on November 1st.

Professor Lester F. Ward gave, last week, a course of six lectures at the University of Chicago, his subject being 'The Evolution of the Plant World as shown by Paleobotany.'

The Secretary of Agriculture will, on November 17th, deliver an address at the opening of the new building devoted to agriculture at the Tuskegee Normal and Industrial Institute for Negroes.

North Dakota Agricultural College and Station have in course of construction a wing for a new chemical laboratory. The laboratory, when completed, will cost $20,000.

The Journal of the Boston Society of the Medical Sciences will be enlarged to octavo size in October. By general consent of the Heads of

Departments it will contain full abstracts of experimental work carried on in the following institutions: the Medical School of Harvard University, the Experimental Laboratories of the Massachusetts General and the Boston City Hospitals, the Physiological and Biological Departments of the Massachusetts Institute of Technology, and Clark University. The numbers of the Journal will be issued promptly after each meeting of the Society, furnishing a very rapid means of communication of the results of investigation. There will be published at least ten numbers a year—running from October to June. The subscription price will be $2.00 a year.

MESSRS. HENRY YOUNG & SONS, Liverpool, announce the publication of the 'Bulletin of the Liverpool Museums,' issued by authority of the City Council. It will be edited by Professor H. O. Forbes, Director of the Museums.

MESSRS. G. P. PUTNAM'S SONS have, in course of publication, in cooperation with Messrs. Bliss, Sands & Co., of London, a series of scientific hand-books to be issued under the title of 'The Progressive Science Series.' The general editorial supervision of the series will be in the hands of Mr. F. E. Beddard, M.A. (Oxon), F.R.S. Each volume will be complete in itself and will be devoted to one distinctive subject. It is not proposed to consider the series from the purely technical side of the various sciences, but social and economic questions will be considered from their scientific aspect. In each treatise it will be the endeavor of the author to present not merely a study of his subject in its present status, but also to indicate the probable lines of future investigations. The publishers promise that the volumes will be fully illustrated, in so far as the subject matter calls for illustrations, and will be suitably and attractively printed and bound. Among the earlier volumes that have been arranged for are:

'The Earth's Structure,' by Professor Geikie.

'Volcanoes,' by Professor Bonney.

'The Science of Ethics,' by M. Berthelot.

'The Cell and Cellular Reproduction,' by Professor Hertwig.

'The Animal Ovum,' by the editor, Professor Beddard.

THE Royal Society of Victoria has issued the ninth volume of the new series of its proceedings, containing papers read before the Society during 1896. These are seventeen in number, including several valuable contributions to the natural history, geology and anthropology of Victoria.

THE *International Journal of Microscopy and Natural Science*, edited since its foundation, sixteen years ago, by Mr. Alfred Allen, and published by Messrs. Bailliere, Tindall & Cox, London, has been discontinued with the present issue. The editor explains that this is due to the sales not being sufficient to pay the printer's bills, but that the Postal Microscopical Society, with which the *Journal* was connected, will be continued.

THE University of the State of New York, following the plan it has adopted of lending to the schools libraries and pictures, offers to make loans of specimens of natural history from the State collections.

AT the recent meeting of the Medical Association of Central New York papers were presented on expert testimony in medico-legal cases, and a committee reported in favor of a change of the statutes, requiring all medical testimony to be brought in by a commission appointed to examine the subject, the medical experts being appointed by the Court as referees, and being paid by the county, not being allowed to receive fees from either the defense or the prosecution.

AT the opening meeting of the Royal Photographic Society, London, the President, the Earl of Crawford, made his annual address, his subject being 'Weights and Measures as they are used in Photography.' He spoke especially of the importance of using the metric system in photography, and urged makers to use the metric dimensions in their cameras, plateholders, etc.

THE London *Times* reports that the experiments in wireless telegraphy which are being made near Dover by the Post Office authorities are being continued, and have reached an interesting stage. They are continued daily with varying results, according to atmospheric con-

ditions. Mr. Preece, the Chief of the Telegraph Department, although he does not personally conduct the experiments, goes down occasionally to witness them and compare results, and advise as to future operations. The authorities are endeavoring to obtain as satisfactory results as those achieved by Marconi, but up to the present time they do not appear to have been so successful. The receiving apparatus is sent out every morning on a trolley, so that it can be transferred to different parts of the country to be experimented with. Strict secrecy is maintained in regard to the instruments, and when the experiments are concluded at the end of the day the apparatus is brought back to Fort Burgoyne and carefully guarded. The experiments are now being made within a radius of three miles of the Fort. Hitherto they have been confined to two miles with the most successful results, messages being freely and distinctly transmitted. At the three miles' radius, it is stated, the results are not nearly so satisfactory. In order to transmit to a greater distance the height of the vertical wire has to be increased. As the pole at Fort Burgoyne is already a considerable height, the use of the flying kite has been resorted to in order to test at still greater heights. The kite is composed of thin copper, a wire running from the tail to the transmitter.

IT is said that Dr. Alexander Edington, Bacteriologist to the Cape of Good Hope government, has found that the blood of animals affected by rinderpest, when treated with citric acid and kept for such a time as to ensure the death of the contagium, will, when injected, immunize all animals exposed to infection. Dr. Edington has practiced his protective injection on several large herds, and always with satisfactory results, the largest mortality having been a little over 3 per cent., or eight animals in a herd of 234.

IT is stated in *Natural Science* that the trustees of the Albany Museum, Grahamston, have decided to erect a new and more commodious building. The necessary funds are already in hand, and the work is to be proceeded with at once. The plans have been prepared by Mr. Viesebosse, architect of the Cape Town Museum. The new museum will be a two-storied building, 150 feet long by about 60 feet deep.

WE learn from *Garden and Forest* that the lumbermen now controling a large block of Big Tree forest, on the western slope of the Sierra Nevada, in California, are making a determined effort to obtain from Congress authority to cut the Sequoia timber in the General Grant National Park. This particular portion of the Sierra Reservation includes about fifteen hundred acres, and is covered with an exceptionally fine growth of Sesquoias and Sugar Pines, probably the oldest living organisms on the face of the globe. As *Garden and Forest* says, every individual is a monument which should be sacredly preserved for the benefit of future generations. To cut down one of these trees is a crime, and it should be a matter of national humiliation that a considerable part of the Sequoia forest has been allowed to pass from government control into the hands of lumbermen. There was no excuse for this; there would be less excuse in allowing those portions of the Sierra forest which have already been reserved for the benefit of the people to be opened to entry. The lumber, even, is not needed by the community, which can be abundantly supplied from the Redwood forests, and no one but a little group of men who expect to make money by this transaction has any interest in the success of the movement.

THE usual annual compilation of statistics relating to mines and quarries in the United Kingdom in 1896 has been issued by the Home Office and is abstracted in the London *Times*. The sources from which minerals are obtained in the United Kingdom are classed under five heads: (1) Mines under the Coal Mines Regulation Act; (2) mines under the Metalliferous Mines Regulation Act; (3) quarries more than 20 feet deep, which are now under the Quarries Act; (4) quarries les than 20 feet deep, which are not under the Quarries Act; (5) brineworks. Except in the case of iron ore and a few less important substances, the present volume contains no account of minerals raised from the quarries less than 20 feet deep. It is true that the amounts of clay, brick-earth, sand and gravel so obtained must be large; but without

further statutory powers no accurate account of the quantity and value can be given. Thanks to the courtesy of the owners, who have furnished returns voluntarily, accurate statistics of the output of the shallow ironstone quarries of the Midlands have been secured; and in like manner the output of salt from brineworks has been calculated. The exports and imports of each of the principal minerals, furnished by the Board of Customs, are given after the tables of production, and in several cases information as to distribution, supplied by railway and navigation companies, is added. Lists of smelters of the principal metallic ores follow the export and import tables, and in the case of iron the quantity of ore and coal used in the blast furnaces, and the make of pig iron, have been ascertained from voluntary returns furnished to the Home Office by the owners. The volume includes a table of the mines inspection districts, with the names and addresses of the inspectors of mines, assistant inspectors, secretaries to boards for examinations, and the Clerk of Mineral Statistics. The return also supplies a general summary of the value of minerals obtained from the colonies. The figures for 1895 were: Africa and Mediterranean, £5,506,739; Asia, £5,874,144; Australasia, £13,919,068; Europe, £139,289; North America, £3,842,586; South America, £446,695; and British West India Islands, £101,550; total, £29,830,071, as compared with £28,765,009 in 1894.

UNIVERSITY AND EDUCATIONAL NEWS.

PROFESSOR JAMES M. CRAFTS has been elected President of the Massachusetts Institute of Technology. Professor Crafts holds the chair of organic chemistry in the Institute and has been the acting president since the death of General Walker.

AT Cambridge University Mr. J. B. Peace, M.A., Fellow of Emmanuel College, has been appointed demonstrator in mechanism and applied mechanics for five years, and Mr. H. Higgins, M.A., of King's College, has been reappointed demonstrator of anatomy for five years.

DR. MOLLIER, of Göttingen, has been appointed professor of mechanical engineering in the Technological Institute at Dresden

THE New York City Board of Superintendents hold an examination for principalships of grammar schools on November 3d, 5th and 8th, which are open to candidates from any part of the United States having an experience of ten years in teaching. The salaries are from $2,500 to $3,500 per annum.

DISCUSSION AND CORRESPONDENCE.

LEWIS ON THE DIAMOND.

IN two papers* recently published Mr. George F. Kunz has reviewed 'Papers and notes on the genesis and matrix of the diamond by the late Henry Carvill Lewis.' In each he attributes to Lewis the theory that South African diamonds have resulted from the intrusion of igneous rocks into and through carbonaceous shales, and the crystallization of the carbon throughout the rock as it cooled, from hydrocarbons distilled from the shale that had been broken through. In his communication to SCIENCE, however, Mr. Kunz admits that in these papers Lewis does not distinctly assert that the shales are the origin of the carbon. Mr. Kunz derives his authority for his representations on this point from conversations with Lewis ten years or more ago.

It seems to me that Mr. Kunz does Lewis a serious injustice. Had the latter wished to commit himself in print to this theory it would have been easy for him to express himself in terms as positive as those which Mr. Kunz employs. Far from doing so he appears to support a radically different theory, viz., that the diamonds are phenocrysts and an integral part of the lava. In the following paragraphs I shall quote every phrase in these two papers which bears on the subject, the rest of the text consisting of lithological discussions and the like.

In his first paper, page 6, Lewis properly attributed the hypothesis of the derivation of the carbon from the shales to Mr. E. J. Dunn.† Lewis expresses no assent to this hypothesis, at least in this connection, and merely comments:

* Production of Precious Stones in the United States, U. S. Geol. Survey, Mineral Resources, 1896; and this JOURNAL, Sept. 17, 1897.

† Quar. Jour. Geol. Soc., Vol. 37, 1881, p. 610.

"If so, the atmosphere would be the original source of the diamond." A little later he remarks:

"The earlier theories as to the origin of the diamond have, in the light of new facts, quite given way to the theory that the diamonds belong to and are a part of the matrix in which they lie, and that this matrix is in some way of volcanic origin, either in the form of mud or ashes or lava." On page 8, however, he says:

"The rock occurs in two types, one not bearing diamonds, the other diamantiferous, and the distinction between them is suggestive. Both occur in the same mine, and are dark, compact, heavy rocks, closely resembling one another, and differing mainly in the fact that one is free from enclosures of foreign substance, while the other is full of fragments of shale and other impurities. It is the latter which is diamantiferous." What is suggested by the difference between these rocks Lewis does not further indicate. He was mistaken as to the facts, as he afterwards appears to have learned.

In his second paper, read in 1887, Lewis, in describing the mode of occurrence of the diamonds, remarks:

"It is interesting also to find that they become more abundant the deeper they are from the surface, and where also the volcanic action was more intense. * * * * * Carbonados and black diamonds are also common, not only in large crystals, but very abundantly as minute, almost microscopic, crystals. The abundance of these minute crystals is another proof that they are not enclosures brought up from some other matrix." He sums up the evidence as to the origin of the diamonds as follows:

"The explorations of the last few years have placed it beyond question that the serpentine rock, called 'blue ground,' is in reality the matrix of the diamond. For a time it was thought that the diamonds were washed into 'kopjes' from above, being mere alluvial deposits, as held by Mr. Cooper and others; afterwards, and until the present time, the idea has been general that they were carried up from below along with other inclusions, and that their true matrix was some gneiss or itacolumite, far below, from which they had become detached by volcanic agency. Others again, such as Döll, hold that, while the serpentinous rock is the matrix of the diamond, the latter is a secondary mineral due to the decomposition of the rock. But recent investigations seem to place it beyond question that diamonds are as much a part of the Kimberley rock as biotite, garnet, titanic and chromic iron and perovskite, and that, like these minerals, they may be considered as a rock ingredient. The fact that they continue just as abundant, if not more so, the deeper the mines are explored: that they are never found in, or especially associated with, the foreign inclusions of gneiss, granite or sandstone: that they are distributed abundantly through all parts of the rock: and that in each of the four principal mines the diamonds have distinctive features of color, lustre and shape, are, with the microscopical evidence of the eruptive character of the rock, strong reasons for holding that the diamonds now lie in their original matrix." This passage will bear but one interpretation and seems to represent Lewis's final opinion.

Later he refers to the fact discovered by Sir Henry Roscoe that the 'blue ground' contains a soluble hydrocarbon, but confines himself to characterizing this as a most interesting chemical observation. Lewis also presents Chaper's results, according to which the rock of the Kimberley mines results from a series of eruptions, between each of which there was time for the volcanic mass to consolidate, and in some of the mines it is possible to make out a chronology of the various eruptions.

The only other passages pertinent in this connection are those referring to the occurrence of fractured diamonds. The fact that fragments of crystals are often found in the mine he explains as due to the bursting of the diamonds on exposure to the atmosphere. He also notes, however, that many of the other porphyritic crystals of the kimberlite are broken.

Whatever Lewis may have said in conversation, his deliberately recorded opinion is that the diamond is a rock ingredient, as much a part of the rock as the garnet or the biotite. It cannot have been his wish to be represented as holding an opinion which, in these papers at least, he nowhere expressed, and from which he withheld his assent.

Lewis never visited Kimberley. I have done so, and from field observations reached the same conclusion as he did from the study of collections. Unfortunately my collection disappeared in transit, but a few notes may tend to throw a little additional light on the subject of the genesis of the diamond.

The De Beers mine and the Kimberley mine are each extensively developed, the former to 1,200 feet and the latter to 1,600 feet. As is well known, the mines are in volcanic necks. I gathered some evidence that these necks are not drilled through the rocks, but are local enlargements of persistent fissures. The adjacent rocks are in a nearly horizontal position and include quartzites, shales, sheets of melaphyre and of basalt. The quartzites are also cut by dikes of basic eruptives. The only bituminous rock in the district is the black shale, which is about 180 feet thick at the De Beers and 250 feet at the Kimberley. At each mine the under surface of this shale is only at the very moderate depth of about 350 feet from grass. In the upper part of the mines the kimberlite carried very numerous fragments of the shale. Below the shale stratum, however, the shale horses or 'floating reef' diminished in number very greatly, so that at over a thousand feet of depth only occasional fragments of shale are to be found. Those which I saw seemed totally unaltered. The edges of the fragments were sharp and there was no macroscopical evidence of any loss of carbon. Much of the lava is brecciated, but much also is solid with gradations between the two varieties. There is one well marked dike in the De Beers. It is known as the Snake, from its meandering course. It was determined by Stelzner as pikrite porphyry and as substantially the same rock as the blue ground itself. The 'Snake,' however, contains no diamonds.

The diamonds are distributed throughout the necks, excepting that they never occur either in horses (whether of shale or of other rock) or in the snake dike. They are found in what appears to be massive lava as well as in the breccia, but there are portions of the mass which are too poor in diamonds to pay for extraction. The diamonds are not grouped about, or especially associated with, extraneous fragments. On the other hand, they are curiously grouped in vertical pipes within the necks. The existence of these pipes was pointed out by Mr. M. Chaper and they were discussed by Mr. A. Moule. The diamonds from the several pipes seem to differ not only in abundance, but also in tint or physical character, so that with care a discrimination is possible. The pipes apparently represent successive eruptions.

It is important to note that the contents of blue ground in diamonds remains very nearly constant at different levels. The De Beers mine is now some 850 feet below the bottom of the shale, the Kimberley about 1,250 feet, and the walls of the necks or of the deposits contain no sensible amount of carbon over these intervals of depth, yet the average number of carats per 'load' of 16 cubic feet (about 1,600 pounds) does not vary to an important extent. The yield per load for the year ending June 30, 1896 (viz., 0.91), was almost exactly the same as for the year ending June 30, 1892 (viz., 0.92). In 1893 it was somewhat higher, in 1894 and 1895 somewhat lower. Now, to imagine that the carbon has come from the shale and permeated the lava downwards, in opposition to the flow of melted rock, to such depths as 1,000 feet, without great diminution of quantity, is almost impossible. One can, indeed, fancy still more deeply seated shale beds, but for this hypothesis there is no evidence at all.

While the diamond appears to be an original constituent of the kimberlite and occurs in South Africa in this manner at many localities, it may be classed as accessory, rather than an essential mineral, if there is any real distinction between these groups. Some of the rock is rich, some too poor to be worked, and some seems to be absolutely barren in diamonds. So also there are basaltic rocks poor in olivine and passing over into varieties substantially barren so far as this mineral is concerned. Similarly granites are sometimes rich in zircon and sometimes poor. Even so-called essential constituents, such as the quartz of granite, likewise vary in quantity, as, for example, when a granite passes over a syenite.

Lewis seems to have confounded two phenomena in discussing fractured diamonds. There are diamonds usually of a brownish tint which, after being exposed to the air for some

time, disintegrate. There are also diamonds of all colors and qualities which are found in the mines in a broken state. These are not cases of fracture in mining, whether by the use of explosives or otherwise. The fragments are embedded in the matrix and the crytals have been broken before final consolidation of the lava took place. They seem precisely analogous to the broken phenocrysts of hornblende or feldspar not infrequently found in lavas and such as Lewis found in kimberlite; it is asserted that in a solitary case two complementary portions of a single diamond have been found, one of them coming from a depth of two hundred feet greater than the other.*

Mr. Kunz inclines to ascribe the fracturing of diamonds to the brecciation of the lava. If this were the correct explanation one would expect to find the diamond fragments only at the surfaces of rock fragments, and to hear of complementary portions of diamond crystals found near together. The few specimens of still embedded fragments which I had an opportunity of inspecting did not bear out the theory of brecciation fracture, and I have noted above the only instance I could learn of in which complementary fragments have been discovered. It seems to me more probable that the diamonds and other fractured phenocrysts in massive lavas have been broken at the moment of explosive ejection from the volcanic melting-hearth.

I am not in a position to discuss Sir Henry Roscoe's discovery of a soluble hydrocarbon in the blue, for I do not know whether the massive lava free from shale, in the deeper workings, does or does not contain it. If it does, the origin of this substance would probably be most easily explained as similar to that of the crystallized carbon, and as due to some such process as that to which Mr. Mendeleeff ascribes the formation of the Baku petroleum, the decomposition of carboniferous, terrestrial, metallic iron.

In closing this criticism it is appropriate to quote the opinion of Mr. Gardner F. Williams,† a mining engineer who for many years has managed the De Beers consolidated mines with conspicuous ability. "The proofs are most conclusive that the diamonds were not formed *in situ*, but have come up from below with the blue ground."

GEORGE F. BECKER.

WASHINGTON, D. C., October, 1897.

*E. J. Loomis, Eclipse party in South Africa, 1896, p. 121.

† Second annual report of the De Beers consolidated mines for the year ending March 31, 1890. In this report Mr. Williams quotes Stelzner as having determined the 'snake dike' as pikrite porphyry and the blue ground as essentially the same rock. The melaphyre sheet underlying the bituminous shale Stelzner considered as olivine diabase. Mr. Williams probably took these determinations from letters, for I can find no publication by Stelzner on the subject until 1893 (Isis Society, Dresden). In this paper Stelzner adopted Lewis' term 'kimberlite' for the blue ground. He assented to Knop's view, that the kimberlite magma was itself carboniferous or hydrocarboniferous and that the diamond crystallized out as a primitive rock constituent. He mentioned, as of special bearing on this subject, a specimen presented by Mr. Williams to the Freiberg Museum, a fragment of diamond which is intergrown with pyrope and is thus presumably from the same habitat as this essential element of the kimberlite.

NOTE ON 'THE EASTERNMOST VOLCANOES OF THE UNITED STATES.'

IN a letter published in SCIENCE (Vol. VI., No. 146, pp. 594–595, October 15, 1897) Mr. Robert T. Hill tries to correct the map showing the distribution of volcanoes in the United States, plate 5, published in 'Professor I. C. Russell's magnificent volume on the *Volcanoes of North America*.' He says the "conclusions on the part of Professor Russell are erroneous and mar his otherwise excellent work, for some of the most beautiful and perfect volcanic craters in the United States occur in New Mexico." Consequently Mr. Hill gives a sketch of the New Mexican region, giving 'supplementary data concerning the distribution of volcanic phenomena.' Among the omissions of the true craters of New Mexico, which have escaped Mr. Russell's notice, the groups of volcanic cones and craters with flows of lava, called the Cerrito, lying between Galisteo and the Rio Grande are quoted in the letter, but erroneously marked in the accompanying sketch as forming a line of three black discs or craters at the western

foot of that part of the Cordilleran mountain series called Sierra de Sandia and bordering exactly the Rio Grande del Norte; just where is situated the town of Albuquerque and the villages of Alameda, Sandia and Bernalillo.

Such erroneous volcanic geography has never been given in a map of the United States even on the most rough sketch.

The group of craters of the Cerrito was first discovered by the present writer in 1853, and recorded as such, on the geological map of New Mexico, 1857, published in Zurich, Switzerland, in *Geology of North America.* They occupy a part of the mesa existing between the southern system of the Cordillera called the Santa Fé Mountains and the northern end of the Sierra de Sandia, nearer to the city of Santa Fé than of Albuquerque, and close to the railroad station called Lamy. The Cerrito lie between Galisteo, Cieneguilla and Lamy. On the sketch map of Mr. Hill, the crater of the old volcano called Cerrito ought to be placed just near the head waters of the Rio Pecos, a little south of the Santa Fé Mountains and northeast of the Sierra de Sandia; and the three black discs of Albuquerque, Sandia and Bernalillo, on the eastern side of the Rio Grande, scratched out.

JULES MARCOU.

GLACIAL STRIÆ.

TO THE EDITOR OF SCIENCE: While strolling over the low hills adjacent to the Delaware river in Northampton county, Pa., I found unmistakable glacial striæ, at least four miles south of the front of the terminal moraine, as commonly defined.

Three parallel scratches, with traces of a fourth, on the sloping side of a shelf of limestone that had just been uncovered from under what seemed a slight bed of true till, and with a direction S. 20 W., made a mistake of judgment, it seems to me, impossible. The repeated occurrence of such ice traces throughout this county to a distance of at least twenty miles south of the moraine most certainly opens for investigation the question of the southern limit of glacial ice.

Yours,

ALBERT G. RAU.

BETHLEHEM, September 15, 1897.

THE ALLEGED EXTINCTION OF LINES OF DESCENT.

PROFESSOR W. K. BROOKS contributed to this JOURNAL some time since (February 1, 1895) an interesting article entitled 'An Inherent Error in the Views of Galton and Weismann on Variation.' The argument of this paper was based on the alleged necessary extinction of lines of descent. Thus Professor Brooks writes:

"Of all the individuals of a species which lived at a given period, very few would have descendants at a later period." "Most of the individuals in each generation must fail to perpetuate their lines to remote descendants." "If a city like Baltimore, where the strangers to each one of us outnumber our acquaintances a thousand fold, could be quarantined against people from outside for a thousand years, each generation would be like the present one so far as known relations are concerned, although at the end of the period the inhabitants would certainly not be descended from the Baltimorians of our day, but from only a very few of them. Most of our lines would be extinct."

I return to the subject because Professor Brooks' statements carry great weight in a subject important for theories of heredity and evolution, and it seems to me that they contain 'an inherent error.' Family names will become extinct, as shown by Mr. Galton, but not lines of descent that have persisted for several generations. If the present population of Baltimore is to remain stationary, some of the inhabitants having no offspring, the others must on the average have more than two. If, for example, we simplify the problem by supposing one-half of the population to be sterile, and each of those who are fertile to have four offspring who survive to maturity, then only one-sixteenth of the fertile parents would have no descendants in the third generation. Of the balance only one line in 256 would become extinct in the fourth generation, one in 65,536 in the fifth, and one in 4,294,967,296 in the sixth. With families of variable size, etc., the calculations would become intolerably complex; but in any population not decreasing in numbers the descendants of each individual tend to increase in a geometrical ratio and cannot become extinct after several generations. If King Alfred and King Alfred's barber had lines of descent lasting several generations, we are each

descended from both of them; or, if not, our descendants (should we have them) will be.

Genealogies are not, as Professor Brooks states, 'represented by a slender thread of very few strands,' but by the branching tree to which he objects, except that there are many trees whose branches interlace and anastomose.

J. MCKEEN CATTELL.

COLUMBIA UNIVERSITY.

SCIENTIFIC LITERATURE.

RECENT BOOKS ON PHYSICS.

Modes of Motion. By A. E. DOLBEAR. Boston, Mass., Lee & Shepard. 12mo. 120 pp.

The second title of Professor Dolbear's little book is 'Mechanical Conceptions of Physical Phenomena.' It is essentially a popular presentation of the fundamental properties of matter as contrasted with those which the author assumes the ether to possess. Matter is contrasted with ether in reference to a series of twenty-two of its commonly recognized attributes, in none of which are the two found identical, and in the great majority of cases they are declared to be directly opposed to each other. Indeed the author makes special effort to demonstrate the absolute dissimilarity of matter and ether, and in so doing even goes so far as to declare that the latter in no way affects the senses. But he evidently believes in the possibility of transforming ether into matter and matter into ether and the indestructibility of matter or the impossibility of transmitting the elements he regards as tentative assumptions. A few sentences are devoted to a consideration of the origin of the ether itself, but the author finds quick refuge in the easy 'assumption that it was in some way and at some time created,' this being, he declares, more rational than to assume that it always existed. The book will be found readable and interesting by students of physical science.

Deductive Physics. By FREDERICK J. ROGERS, M.S. Ithaca, New York, Andrews & Church. 8vo. 250 pp.

This book deserves consideration by all who are seeking a satisfactory college text-book of physics. It is in many respects different from any of the almost innumerable candidates for this distinction that have appeared during the past decade. Of these nearly every one has its merits and all have faults, but the variety is so great that the special necessities of almost every situation can be satisfied. There has been, however, a regrettable tendency in two directions. On the one hand, there have appeared several treatises very complete, very well prepared, but so large as to be really formidable and quite impossible of mastery in the time usually allotted to this subject in the college curriculum. The use of these compelled the adoption of the plan of omitting or 'skipping' many pages or even chapters, which is by no means to be commended under all circumstances. On the other hand, many college text-books are offered in which laboratory exercises are made so prominent as to seriously interfere with and often absolutely prevent a proper appreciation of the 'theory of physics.' Within a few years a few books have made their appearance in which both of these evils have been largely avoided and in which it has been attempted, as in the volume under consideration, 'to present, in compact though logically complete form, the principal facts, laws, definitions and formulas of the science of physics.' In the present instance the author has enjoyed a large measure of success. His definitions of fundamental terms and principles are, in the main, sound and discriminating. Although the discussions are generally concise, they are generally satisfactory, and no important phase of the subject has been entirely omitted. The illustrations are diagrammatic and clear and the leading propositions are illustrated and enforced by well-selected problems. No attention is given to experimental or laboratory exercises, but it is assumed that these accompany the use of the book whenever possible. In the opinion of the writer the author has made a mistake, unfortunately not an extremely uncommon one, in introducing several unauthorized and not generally recognized names for derived units, such as *kin*, *gramkin*, *spoud*, etc. This tendency towards multiplication of unit names has little to commend it and there is serious objection to it. It was the unanimous decision of the Chamber of Delegates of the International Electric Congress of 1893 that in electricity and magnetism

it was unwise to increase unit names beyond the small number then well fixed in actual use. The subject has been much discussed and it is believed that the weight of authority is against it. The student of physics and mechanics often loses sight of the thing and its derivation when a distinctive name is given to it, and while it is extremely convenient to distinguish by names a few of the fundamental and most important units of measure the number should be kept at the lowest possible limit.

Problems in Elementary Physics. By E. Dana Pierce. New York, Henry Holt & Co. 12mo. 200 pp.

This book is intended for use in secondary schools along with some suitable text-book and with laboratory exercises. It contains a tolerably extensive series of problems illustrative of the quantitative character of the science and the exactness of its conclusions. They are, in the main, well selected and properly distributed. Occasional definitions, formulæ or brief explanations are inserted, intended to be suggestive of the principles involved in the solution of the problems. Some of the problems and statements are open to a criticism applicable to nearly all text-books of this class. They are mostly written by teachers in preparatory schools who have never themselves (it must be inferred) enjoyed a very thorough training in physics. This is shown in the common failure to recognize the *limitations* to which almost all laws are necessarily subject, or the restrictions which must guard their enunciation. It is impossible, of course, to assume that the teacher of elementary physics should know all of these, as it is impossible for the college professor, who is a specialist in the subject, to know them, but it is not impossible to avoid some of the more common errors of statement, and it would be of enormous value if both teacher and pupil could know and never forget that most of the simple statements of physical laws, either by word or by formula, imply a simplicity of condition which never actually exists in nature. It requires some knowledge, but not much extra time and trouble to guard instruction in this line and the result is worth many times the cost. The lack of this is shown in a certain 'cocksureness' in elementary text-books and laboratory guides, as to what will or will not happen if you do so and so, and because the thoughtful and careful student is very likely to find that if things do *not* happen as described he is in danger of losing both confidence and interest. Nearly all books of the class under consideration abound in examples of this sort of thing. Instruction in physics in the secondary schools under the newer or laboratory methods is by no means the success that it is represented as being by those who have been its most active propagandists and the difficulty is not so much that lack of accurate scholarship has made a rigorous presentation of principles impossible, but rather that the great underlying philosophy of inductive science has continued unknown to both teacher and pupil.

M.

Insect Life. An introduction to nature-study and a guide for teachers, students and others interested in out-of-door life. By John Henry Comstock, Professor of Entomology in Cornell University and Leland Stanford Junior University. With many original illustrations, engraved by Anna Botsford Comstock, member of the Society of American Wood Engravers. New York, D. Appleton & Co. 1897.

In the college education of the present time nearly all science teachers are agreed that the introduction to natural history studies should begin in the lower schools, that instruction in biology should be as much a matter of requirement in the preparation for college as the study of foreign language. Many instructors of science in the colleges, while thoroughly believing that the principle is an excellent one, are not at all enthusiastic in the enforcement of such requirements, since natural history instruction in the preparatory schools is, as a rule, lamentably bad. A few perfunctory lessons in plant analysis, with neither enthusiasm nor knowledge on the part of the teacher, and much book work by rote is the rule rather than the exception, at least in the Western schools. It hardly matters what the boy or girl studies, so long as it is living organisms, if studied in the right way, and the right way is nature

itself. The training of the observational faculties is what the college instructor in natural history more especially desires in the preparation for higher work, and it matters little whether that training has been obtained in the study of botany, zoology, physiology or geology.

In the little work that has recently been published by Professor and Mrs. Comstock another step in the right direction has been made. The material for instruction in entomology is everywhere at hand, summer and winter, and for its abundance, diversity and instructiveness is unexcelled in any department of elementary biology; and 'Insect Life' has made the way plain for this elementary instruction in high schools and the higher grades of the grammar school under intelligent teachers. The work is an introduction to the study of animal life, calling for direct observation on the part of both teacher and pupil, and it is a better text-book for elementary instruction than any general work on botany or zoology can be, for classification is only an incidental part of the book. Excepting a few elementary chapters on the anatomy, metamorphoses and classification of insects, nearly the whole book is devoted to nature-study of the more familiar insects in their own haunts and in the laboratory. The concluding chapters tell in simple language how to prepare and preserve specimens for the cabinet. The pupil is encouraged to make a special study of some branch, and there can be no question but that such special study will do more to quicken his powers of observation and his enthusiasm than any amount of generalizations. The book fills a unique place in entomological literature and is to be highly commended. It is written simply and is fully and admirably illustrated by Mrs. Comstock.

S. W. W.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON. 279TH MEETING, SATURDAY, OCTOBER 9TH.

MR. L. O. HOWARD exhibited a specimen of the Giant Water Beetle of Cuba.

Mr. R. T. Hill, under the title 'Notes on Antillean Faunas, Past and Present,' gave a resumé of his studies on the geology of the region, describing the various upheavals and subsidences that had taken place and their effects on the fauna of the West Indies and particularly of Jamaica. He stated that communication between the Pacific and the Gulf of Mexico was cut off much earlier than had been generally supposed.

Professor Barton W. Evermann spoke of 'The Catfish of Louisiana,' stating that few were aware of the extent of the fishery, 2,000,000 pounds being shipped annually. Two species were taken, *Ictalurus furcatus* and *I. nigricans*, the latter species having for some time been regarded as belonging to the genus *Amiurus*. During low water the fishes were taken in the bayous by means of extremely long trout lines, but during high water they were taken in the flooded woods, mostly on single lines.

Dr. Theo. Gill discussed 'The Inadequacy of the Order Bunotheria,' stating that the group was not a natural one.

F. A. LUCAS,
Secretary.

NEW YORK ACADEMY OF SCIENCES, SECTION OF GEOLOGY, OCTOBER 18, 1897.

THE first meeting of the Section for the autumn was largely devoted to accounts by various members of the scientific meetings of interest held during the summer. President Stevenson spoke briefly of the work of the International Congress of Geologists at St. Petersburg. The Secretary spoke of the work of the Geographical Section of the British Association for the Advancement of Science, at Toronto, and Professor Martin gave a similar account of the work of the Geological Section at the same meeting. The principal paper of the evening, apart from these descriptions, was by Mr. Charles Bullman, who gave a descriptive account of the location and character of the auriferous gravels of the State of Colombia, illustrated by many specimens. In the opinion of the speaker, the auriferous gravels are of wide distribution and thickness, and of exceeding value, and much more extensively distributed than stated by Mr. F. C. Nicholas, who gave a paper before the Academy on the same topic at one of the spring meetings. The speaker believes that the gold deposits are still being laid down with consider-

able richness and that the whole area around the San Juan river is extremely rich in auriferous deposits. The paper was discussed by Mr. Nicholas, who reiterated his statements that the gold-bearing clay deposits are not as extensive as they at first may seem to be, and that they are isolated to a few small localities now being dissected and drained by small streams.

RICHARD E. DODGE,
Secretary.

ANNUAL MEETING OF THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE annual meeting of the New York Section of the American Chemical Society was held at the College of the City of New York on Friday evening, October 15th, Dr. William McMurtrie presiding and fifty-two members present. The result of the election of officers for the ensuing year was as follows: Dr. William McMurtrie, Chairman; Dr. Durand Woodman, Secretary and Treasurer; Drs. C. A. Doremus, A. C. Hale and A. A. Breneman, Executive Committee; Dr. McMurtrie, C. F. McKenna and Marston T. Bogert, Delegates to the Scientific Alliance of New York.

Brief remarks were made by the Chairman on the death of Dr. M. Alsberg, one of the eight original founders of the Society, and an obituary notice by Dr. H. Endemann was read by the Secretary.

A paper was read by Professor P. C. McIlhiney on 'Some Experiments on Thermo-electric Pyrometry,' in which a very expensive form of electric pyrometer was described and directions given for its arrangement. Dr. McMurtrie made an address on 'Recent Progress in Industrial Chemistry,' after which a vote of thanks was unanimously passed to the Chairman for his faithful and energetic efforts during the year to make the meetings interesting and successful.

DURAND WOODMAN,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis, held on the evening of October 18, 1897, the Secretary presented in abstract a paper by Frank Collins Baker, entitled 'The Molluscan Fauna of Western New York,' dealing with specimens collected by the author between July 5 and July 29, 1897, and based on some 1,500 specimens, representing 75 species, and giving exact data concerning weather, temperature and altitude for each station in 19 different localities visited. The paper enumerates 146 species and 10 varieties, including those previously recorded for the section with which it deals. The lingual dentition of *Bythinia tentaculata* is described and figured, and several species have been subjected to critical review.

Professor H. A. Runicke made some informal remarks on recent progress in our knowledge of the constitution of steel, with reference both to its microscopy and chemistry.

WILLIAM TRELEASE,
Recording Secretary.

NEW BOOKS.

Sleep; Its Physiology, Pathology, Hygiene and Psychology. MARIE DE MANACÉÏNE. London, Walter Scott, Ltd.; New York, Charles Scribner's Sons. 1897. Pp. vii + 341. $1.25.

Elements of Comparative Zoology. J. S. KINGSLEY. New York, Henry Holt & Co. 1897. Pp. vii + 357.

Children's Ways. JAMES SULLY. New York, D. Appleton & Co. 1897. Pp. viii + 193. $1.25.

The Living Substance as Such, and as Organism. GWENDOLEN FOULKE ANDREWS. Boston, Ginn & Co. 1897. Pp. 176.

Light, Visible and Invisible. SILVANUS P. THOMPSON. New York and London, The Macmillan Company. 1897. Pp. xii + 294.

Ordinary Differential Equations. JAMES MORRIS PAGE. New York and London, The Macmillan Company. 1897. Pp. xviii + 226. $1.25.

A Text-Book of Special Pathological Anatomy. ERNST ZIEGLER. Translated and edited from the eighth German edition by Donald MacAlister and Henry W. Cattell. Sections IX.–XV. New York and London, The Macmillan Company. 1897. Pp. xv + 579—1221 + xxxi. $4.00.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; C. E. BESSEY, N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; C. S. MINOT, Embryology, Histology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, NOVEMBER 5, 1897.

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THE GEOLOGICAL CONGRESS AT ST. PETERSBURG.

THE Seventh International Geological Congress convened at St. Petersburg, Russia, on August 29, 1897, in accordance with the Czar's invitation, presented at the Fifth Congress in 1891.

The enrollment far exceeded that of any previous Congress, the preliminary list showing 966 names, of which only 270 were of Russians. The final list has about 1,100, about 120 of them being American.

The arrangements were upon an imperial scale. Free transportation on all Russian railroads was provided not merely for the members, but also for their families. Excursions were given such as no other Congress can expect, unless, indeed, another meeting be held in Russia. A guide book of 660 pages, with many maps, plates and sections, was prepared, giving detailed information respecting the geology of regions to be visited, a most valuable contribution to geological literature, making accessible, to geologists all over the world, facts previously published for the most part only in proceedings of scientific societies and sealed up in the Russian language.

Three excursions preceded the Congress. That to the Ural Mountains, shared in by somewhat more than 200 members, was in charge of Dr. Tschernychew and lasted for four weeks. This, extending beyond railroad and all other ordinary means of trans-

portation, afforded opportunity for the study of localities almost inaccessible to travellers. That the journey was completed with so little discomfort and with so great advantage to those taking it reflects great credit upon Dr. Tschernychew's management. The excursion to Finland, in charge of Dr. Sederholm, was taken by somewhat more than 100. That region is not so far in miles from civilization as is that of the Urals, but the perplexities of one in charge of a large party are hardly less. The success of this excursion was complete, and Dr. Sederholm earned the gratitude of those who accompanied him. The Esthonia excursion, under Dr. F. Schmidt, had only twenty-five members, but, according to the testimony of them all, the two weeks were spent pleasantly and with great profit.

A fourth excursion began on September 5th, at the close of the Congress. This was to a more distant part of the empire, extending to the Caucasus and in one division to Mt. Ararat.

During the week allotted to meetings of the Congress, two days were given to excursions. One to Peterhof, the summer palace of the Czar, was for pleasure only; the other, combining pleasure and instruction, was to the Falls of Imatra—a long excursion in short time. The excursionists left St. Petersburg at 6:30 a.m. and reached the Falls at 1 p.m. They remained there until 7 p.m. and then returned, reached St. Petersburg at 1 a.m., thoroughly fatigued for the most part, but well repaid. The hospitality in the city began to manifest itself on the evening prior to the assembling of the Congress, when the Committee of Organization gave a reception to the members at the Germania club. On August 30th the Grand Duke Constantine gave a reception at his palace to about 200 delegates and the Mayor of the city held a grand function at the Hotel du Ville on September 2d.

The Congress was opened at noon on August 29, 1897, in the large hall of the Zoological Museum of the Academy of Science. Addresses of welcome were delivered by the Grand Duke Constantine, the Princess of Oldenburg and the Minister of Agriculture, to which Professor Capellini replied on behalf of the Congress. The list of officers prepared by the Bureau was read by Professor Renevier and chosen by the Congress, after which an address was made by Professor Karpinsky, the President, who was followed by Dr. Tschernychew, the Secretary-General, who outlined the business which would be presented by the Council. A brief address by the President of the Geographical Society closed the exercises and the Congress adjourned for the day.

The Congress sat twice each day on Monday, Wednesday, Friday and Saturday. The morning sessions were devoted to discussion of principles of nomenclature and to transaction of such matters as were presented by the Council, while those of the afternoon were taken up in the reading of memoirs.

The morning discussions were simplified greatly by the memoirs of Bittner, Loewenson-Lessing and others prepared at request of the committee and printed prior to the Congress. It must be conceded that the results of these discussions do not appear at first glance to be of very great importance; the points agreed upon were such as impose no burdens and they were adopted unanimously. But where the question proved to be serious and material differences of opinion seemed likely to develop, the matter was referred to a committee for consideration and for report to the next Congress. This, however, was the wisest mode of procedure. The Congress has no power to bind its members except in so far as they consent, so that it is not the place in which to thrust one's conceptions too

strongly. Any matter which does not commend itself readily at the first presentation should be laid aside promptly, that no member be allowed to express himself in such manner that his *amour propre* would be wounded in case the vote should go against him. All of the matters referred will be considered carefully by the committee as well as by a great part of the membership during the next three years, and there will be little difference of opinion respecting important matters at the Congress of 1900.

The reading of memoirs was somewhat perfunctory, or rather the listening was so. The feeling seemed to be that these would be printed and that members would have opportunity to digest them at leisure. Several reports were presented by committees, and they will be published in the volume of proceedings. A committee was appointed to consider the principles of chronological classification of sediments and another to consider the propriety of establishing an international journal of petrography. The Congress expressed itself as earnestly favoring the establishment of a permanent floating institute to carry on work such as that of the Challenger expedition, and also as favoring the developing of geological courses for higher classes in lycees and gymnasia. The members were called upon to urge these matters upon their governments.

The Congress adjourned on September 5th, to meet in Paris in 1900.

The real value of this as of previous Congresses is not to be measured by the list of memoirs or by the records of discussions. Important as those may be, they are of vastly less importance than the actual contact of men coming from all parts of the world. Geologists from Asia, the Pacific islands, the Americas and almost all nations of Europe met together; too often known to each other previously only as streaks of printers' ink, they became actual entities; those devoted to similar studies found opportunity to compare observations; many, whose conceptions of phenomena were limited by the little area of their country, have gone home with a broader knowledge; and a long step has been taken toward binding together our men of geology. The true work of the Congress was done not so much in the sessions as in the huge lobby, wisely provided, where those of like minds were gathered in little clusters making liberal dividends of knowledge. This feature was recognized as all important by the Committee of Organization, which, with this in view, planned the excursions on which so much of the real work was done.

To speak of individual members of the Committee of Organization as especially worthy of remembrance may seem ungracious when all were so untiring, but one cannot refrain from acknowledging the indebtedness which all must feel to Karpinsky, Tschernychew, Nikitin, Chrustchoff and Michalski, while the Americans will remember pleasantly the courtesies rendered by Mr. Gardiner, the only American student in the University of St. Petersburg.

JOHN J. STEVENSON.

NEW YORK UNIVERSITY.

A NEW INVESTIGATION OF MAN'S ANTIQUITY AT TRENTON.

I.

A RENEWED search for evidence of glacial man at Trenton induced Professors G. F. Wright and Arthur Hollick, Messrs. H. B Kümmel and G. N. Knapp, of the New Jersey Geological Survey, and myself, on June 25, 26, 27 and 28, 1897, to explore a site on the summit of the glacial gravel terrace at Trenton, where Mr. Ernest Volk*

* Working under the direction of Professor F. W. Putnam for the New York Museum of Natural History, Mr. Ernest Volk was generally present at the

has alleged the discovery of artificial argillite flakes, and other relics of human handiwork, in a yellow sand of supposed glacial age under a surface loam stratum indicating Indian occupancy.

Five trenches (Trench A, $21\frac{1}{2}$ ft. by $3\frac{3}{4}$ ft. by 3 ft. 3 in. deep; B, $7\frac{3}{4}$ ft. by $4\frac{1}{2}$ ft. by 3 ft. 3 in. deep; C, 6 ft. by 6 ft. by 2 ft. 8 in. deep; D, $4\frac{1}{2}$ ft. by $4\frac{1}{2}$ ft. by 3 ft. 3 in. deep), sunk over an area 90 ft. long by 33 ft. broad,* well upon the flat summit of the terrace, with Trench D, about 80 ft. from the outer brink, revealed clearly:

Layer 1.

(10 inches to one foot).

A discolored surface loam, disturbed by recent cultivation, mixed with the remains of the Indian and white man. It contained:

	Specimens.
Blocked-out blades, Argillite	3
Blocked-out blades, Chert	2
Argillite blade, long, narrow (spear form)	1
Arrow-head, broken, Jasper	2
Arrow-head, broken, Chert	1
Hammer stone, pebble, fragment	1
Animal bones, with large scapula, probably Elk splintered limb bones and limb bone of a bird	22
Mussel shell (Unio) fragments	6
Pebbles, probably fire-cracked	131
Teshoa or pebble flake, scraper?	1
Argillite flakes, probably artificial, generally with green patina	19
Chert flakes, probably artificial	11
Jasper flakes, probably artificial	5
Stone (unidentified) flakes, probably artificial	6
Quartz and Quartzite fragments	5
Potsherds, Indian (8 found together)	9
Pebbles unworked; size, from that of robin's egg to goose egg; largest 4 in. in diameter	55
Miscellaneous stones, mostly pebble fragments	103
Oyster shell	1
Cinder fragment	1
Anthracite coal fragments	2
Glazed potsherds	2
Brick fragment	1

Below layer 1, and as the chief center of observation and interest, rested

Layer 2.

(18 inches to 2 feet).

Composed of a fine yellow sand, streaked towards its lower portion with fine irregular films of reddish sandy clay which thickened and coalesced at the bottom into a distinct harder red band.

Advancing slowly into layer 2 with trowels against the sides of the trenches where the stratification had been exposed in vertical section, we pulled out one by one the pebbles, broken stones and artificial chips, etc., described below, giving special attention to the large pebbles and the chips most artificial in appearance, calling the attention of all our colleagues to each large object, when it first clinked against the trowel's edge so that its depth could be measured and its position with reference to the clay films, observed by us all before its removal.

The objects thus found (after discarding those resting in the upper part of the layer for about four inches below the bottom of layer 1 as pertaining to what we called the zone of doubt) were as follows:

ARTIFICIAL FLAKES.

NOTE.—The numbers in inches after the specimens indicate the depth in Layer 2 below the zone of doubt, the letters the trench referred to.

	Number of Specimens.
Jasper, 10 in.	1
Jasper, 12 in.	1
Quartz, 4 in	1
Argillite green patina, $6\frac{1}{2}$ in	1
Sandstone or Argillite, $2\frac{1}{2}$ in	1
Argillite lying flat, $3\frac{3}{4}$ in	1

digging and hospitably offered us every assistance, being seconded by the kindness of the owners of the property, the Misses Lalor, who generously placed their land at our disposal. Dr. Charles C. Abbott was continually present, and Dr. Harrison Allen, of the Academy of Natural Sciences, of Philadelphia, visited the Trenches on Sunday, June 27th.

* Kindly reserved for our use by the Misses Lalor, owners of the property, for whose generous hospitality we herewith return our thanks.

Argillite, 7 in 1
Jasper, 12 in 1
$1\frac{3}{8}$ *in. wide,* $\frac{1}{8}$ *in. thick, Trench A 2 in. resting on its side below a thin film of reddish clay. The film waved from one side of the trench to the other over the specimen, becoming slightly thinner and fainter directly above it, though without showing signs of break. Photographed in place, 20 in.* See Figs. 1 and 3 1
Argillite green patina, about 1 in. in diameter, possibly artificial, resting exactly in line of clay film, 12 in 1
Quartzite, possibly artificial, 8 in . . . 2
Chert (resting indubitably in films of sandy clay. Trench B. Photographed in place,

FIG. 1.—View of face of Trench A, showing Argillite specimen (see middle right-hand specimen in Fig. 3, Professor Hollick's paper) resting in place, 20 inches down, in the yellow sand at base of the rule. The trowel scratch marks the position of the film of stratification just above the specimen. The lower scratches mark the thickening of these films at the base of the yellow sand. From surface to trowel, Layer 1 (Indian), ten inches to one foot. From trowel to series of scratches, Layer 2, yellow sand, relic bearing, eighteen inches to two feet. Below scratches coarse sand and gravel, non-relic bearing. Specimen photographed in place June 26, 1897, by Ernest Volk, in presence of G. F. Wright, H. B. Kümmel, C. C. Abbott and H. C. Mercer.

signed G. F. Wright, Arthur Hollick, H. C. Mercer). See Figs. 2 and 3 (in Dr. Hollick's paper), 12 in. 1
Flakes Argillite, small below clay film, Trench B., 14 in 1
Quartz, Trench B., 8 in 2
Quartzite pebble, 10 in 1
Argillite, possibly artificial C., 12 in . . 1
Quartzite, possibly artificial C., 10 in . . 1
Jasper, possibly artificial C., 6 in . . . 1
Argillite, possibly artificial C., very small piece, $2\frac{1}{2}$ in 1
Chert from pebble, 6 in 1
Argillite, possibly artificial, 3 in. long by $1\frac{3}{4}$ wide, green patina under a very distinct film of reddish sandy clay, Trench C., 19 in 1
Argillite, possibly artificial, exactly in line of heavy red film and 6 in. below fainter film C., 16 in 1
Quartz, possibly D., 6 in 1
Chert from pebble, 6 in 1
Argillite, probably artificial, bedded in filmings of reddish sandy clay not immediately overlaid by a continuous film, but rather by faint reddish broken streaks D, 15 in 1
Argillite patinated, $2\frac{3}{4}$ in. long, $1\frac{1}{2}$ in. wide, $1\frac{1}{8}$ in. thick, probably artificial, resting in series of clay films less clearly marked than in the other trenches, but nevertheless extending over the specimen in a series of blotches, D, 16 in . 1
Argillite piece, possibly artificial, on film, 15 in 1
Argillite piece, possibly artificial, on C, 12 in 1

Total 30

ANTHRACITE COAL.

Small fragment size of hazlenut, below zone of doubt, in yellow sand 1
Anthracite coal, small piece size of hazlenut, C, $3\frac{1}{2}$ in 1

Total 2

ROOTS.

In all the trenches, various sizes from fine rootlets to size of middle finger, various depths.

PEBBLE USED.

Battered on end, 6 in 1

Total 1

PEBBLES, UNUSED.

Depth, 9 in	1
Largest, size of pigeon egg; smallest, size of pea (various depths)	75
2 in. below red film, under which chipped Argillite was found lying flat, 16 in	1
Large pebble resting directly upon clay film, 17 in., 8½ in. long, 4¾ in. wide at widest, 2½ in. thick	1
Flat, 16 in	1
Large in Trench A, 15 in	1
1½ in. in diameter, 4 in. under film	1
18 in	1
Under film, 16 in	1
Unused, large in film, 16 in	1
Small, 16 in	2
Small, 16 in	3
Most of the pebbles saved from 1 in. to 2 in. in diameter.	
Large, about 4 in. in diameter, broken, showing on one side, according to Mr. Kümmel, facets of wind erosion, in film, 14 in.	1
Weathered, 2¾ in. long, 2 in. wide, 1½ in. thick, resting below a distinct film and above another, 17 in.	1
2¼ in. long on film, 16 in.	1
3 in. in diameter, Trench D, 6 in. on film	1
1 in. in diameter on film, 18 in	1
On film, 18 in	1
Size of large Chestnut on film, 20 in	1
Smaller below film, 14 in	1
Hazlenut size, 14 in	1
Unused, 3½ in. long, 2½ in. wide, ⅜ in. thick	1
Various depths	27
Various depths, Trench B	64
Various depths, Trench C	26
Lower part of stratum, various depths.	16
2 in. long, 1¼ in. wide, near three smaller pebbles	6
2 in. below red film, 16 in.	1
(Large, 7½ in. long, 5½ in. broad, 3 in. at thickest, broken, upper side roughened but not certainly wind-worn, C, 16 in.)	1
D, various depths	13
Total	254

PEBBLES FRACTURED.

2 in.	1
4 in.	1
9 in.	1
Small fragment, Trench B, 9 in.	1
Small piece, probably broken by fire, 5 in.	1
In connection with black streak extending down from surface,	2
Small piece, 2 in.	1
Total	8

MISCELLANEOUS STONES. PROBABLY NOT ARTIFICIAL.

Flat Sandstone fragment, 18 in	1
Jasper (?) fragment, 10 in	1
Quartzite (?) fragment, 18 in	1
Argillite (?), 13 in	1
Unidentified piece, 6 in	1
Flat stone, possibly chip, 12 in	1
Argillite piece, vertical position, 6 in	1
Argillite piece, 7 in	1
Quartz piece, flat, 4 in	1
Argillite piece, flat, 1½ in	1
Sandstone fragment, 4 in	1
Shale piece, 2½ in	1
Quartz fragment, 2½ in	1
Red Shale fragment close under faint red clay film, 18 in	4
Argillite chip, possibly artificial, 12 in	1
Shale fragment, 3 in. diameter, 18 in	1
Argillite fragment, Trench C., 10 in	1
Quartz, depth not marked	1
Quartzite fragment, 6 in	1
Argillite fragment, 6½ in	1
Total	23

ANT GALLERIES.

About size of string-bean pod, not so long, 1 in. below irregular filmings, penetrating film by narrow hole, size of timothy grass, D, 16 in.	1
Size of lima bean, under clay film, just above which is another similar gallery, containing eggs, Trench D, 22 in.	1
½ in. horizontal diameter, ¼ in. vertical, 1½ in. below middle film, followed inward and lost without tracing upward through film, Trench B, 11 in	1
Total	3

CONCLUSION.

Fifty stone flakes mostly man-made, not of argillite alone, as we had been led to expect, but of argillite, chert, jasper and quartz, one battered pebble and two fragments of anthracite coal, thus positively

found in the much discussed stratum of yellow sand which we have called Layer 2, present us with interesting evidence as to the relation of the sand stratum to man; while in the further presence of twenty-three miscellaneous stones, and two hundred and fifty-four water rolled pebbles, ranging in magnitude from the size of a chestnut to that of an ostrich egg, we are confronted with interesting considerations as to the deposition of the sand, whether by wind or water.

The antiquity of man, at the site, judged by these observations, depends on three questions:

1. *Are the significant chips in the yellow sand artificial?* To which my experience answers yes.

2. *Are they in situ in the yellow sand?* To this I would say that the notion of the intrusion of objects from the Indian surface layer above (Layer 1), down and into the sand below (Layer 2), is suggested to me for the following reasons: Because the deepest artificial specimen in the yellow sand (Layer 2), rested not over three feet below the surface; because the range of stone chips (argillite, jasper and quartz) and fractured pebbles was identical in the yellow sand (Layer 2), and the Indian Layer (Layer 1), and showed thickest under the latter, growing thinner downward; because argillite chips identical in character and equally decomposed and patenated occurred in both layers; because two pieces of anthracite coal were found in the upper part of the sand (Layer 2), and, lastly, because the artefacts were scattered at irregular depths in the sand (Layer 2), nowhere suggesting by their collocation a floor of occupancy or workshop abandoned by primitive man.

On the other hand, neither the shallow depths of the objects nor the closeness of the layers exceeded conditions known to archæology where divergent culture epochs had been found to rest closely one upon another. And while no potsherd or bone was found below (in Layer 2), the similarity of the stones used where the blade material (ingredient to glacial gravel) had continually remained the same failed to overweigh the probability of antiquity as to the specimens from the lower layer. Coal fragments not uncommon in the alluvium of the Delaware, whose trough traverses coal beds near Mauch Chunk, had been found by me in an underplaced Indian village layer, probably pre-Columbian, at Upper Black's Eddy,* while the observed position of roots and the study of small ant galleries failed reasonably to account for the site of the chips in Layer 2, whose position in several cases beneath well observed and unbroken films of stratification remained the most important fact in the evidence.

When all was considered I was forced to conclude that a significant number of artificial chips rested in situ in the sand, and hence were of an age antedating its deposition.

Here again, as at the underplaced layer at Lower Black's Eddy, we were confronted by two thin strata of human occupancy, resting one upon the other, but separated from each other by an interval of time as yet unmeasured.

Antedating the familiar Indian, preceding the birth of the known riparian forest as indicated by the superficial blackness of its plant-stained loam, the immediately underplaced yellow sand Layer 2, close beneath the surface as it lay, testified to the previous presence of a chipper of argillite, jasper and chert, and a bruiser of pebbles, upon the surface of the bluff. As before remarked, the bones of animals and pottery, characteristic of the upper layer, were ab-

* See researches upon the antiquity of man in the Delaware Valley and the eastern United States. Publication of the University of Pennsylvania, Vol. VI., p. 78. Ginn & Co., Boston. 1897.

sent in the lower; otherwise, no marked difference appeared in the kind of stones used, their patina, or mode of fracture.

From the evidence previously produced by the more notable explorations of the Trenton site, the present testimony differs in several particulars. The shallow zone of discovery, ceasing at about three feet below the surface, failed to encroach upon the region (10, 20 and 30 feet deep in the immediately underplaced gravel) alleged as the horizon of previously excavated human relics. No series of ovate blades resembling the drift specimens of France and England appeared as in previous years, to out-classify all other objects; while the contention (unreasonably over-valued in our opinion) in favor of the absence of jasper in earlier human horizons was not sustained by our discoveries. Nevertheless the existence of man upon the bluff top under topographical conditions differing from those of the present had to to be admitted.

This granted, however, the question of human antiquity at the site depended not so much upon the evident priority of the sand relics to the Indian remains of the surface loam as upon the length of time of such priority—namely, upon the final space question:

3. *What was the age of the sand?* Extending outside the province of my qualification, this question remained to be settled by my colleagues. Let their special experience decide whether this yellow layer resting exactly upon the Trenton gravels is a true part of their composition. Was this overlying sand the work of the river swollen to excessive volume by the melting of the great glacier? Had modern rivulets, since drained away, spread it upon the terrace top? Or, during the time before trees grew and loam formed, had wind whirled it, pebbles, clay films and all, upon the even table of the bluff?

Henry C. Mercer.

II

On June 25th, by invitation of Professor G. Frederick Wright, the following party met at Trenton, N. J., to make excavations in the Trenton gravel terrace, and to examine any archæological material which might be brought to light: G. Frederick Wright, Oberlin, Ohio; H. C. Mercer, Doylestown, Pa.; C. C. Abbot, Trenton, N. J.; Ernest Volk, Trenton, N. J.; Arthur Hollick, Staten Island, N. Y., and a workman to perform the rough digging.

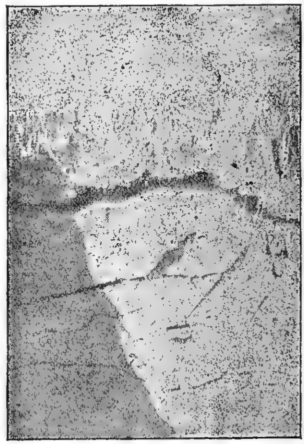

Fig. 2. Artificial chert specimen (see also upper right-hand specimen, Fig. 3, on next page) photographed as found in place in the yellow sand. The trowel scratches show the line of films of stratification above and below the object. The dark, deep scratch marks bottom of Layer 1 (Indian), 10 inches to 1 foot. Yellow sand, Layer 2, extends downward from heavy trowel streaks. Photographed by Mr. Volk in the presence of Professor Wright, Dr. Hollick and Mr. Mercer.

Through the kindness of the Misses Lalor, a part of their farm, favorably located on the edge of the terrace, had been reserved for investigation. Upon the surface of this part an area about forty feet long in a north

and south direction, by about four feet wide, was selected by our party for excavation. Our workman first removed the surface soil by spading and shoveling, to a depth of about six inches, and threw it to one side. This soil was found to consist of a fine yellow-brown sand, mixed with humus and other carbonaceous matter, which gave it a prevailingly dark color. All objects thrown out with this soil were collected and listed tery; unclassified stones, mostly broken or chipped. The entire collection apparently represented the ordinary refuse of an Indian camping ground, with a few indications of modern civilization.

At the southern end of the area from which the surface soil had been removed, a pit was excavated 4 ft. by 4 ft. by $3\frac{1}{2}$ feet deep. The sides of this pit were carefully squared and showed the following section:

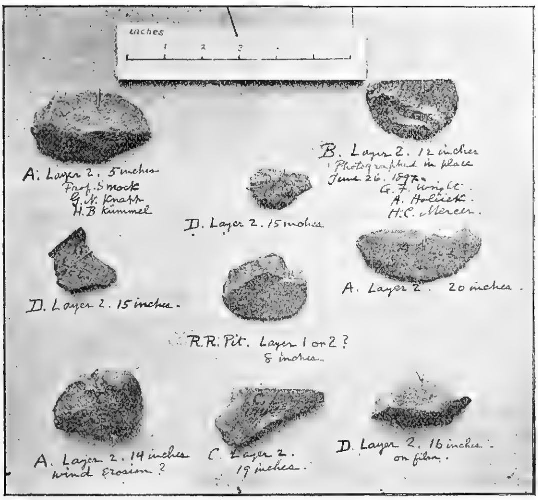

FIG. 3.—Weathered pebble, artificial flake of chert and flakes of argillite, described in the text, except one on the upper left-hand corner, found at significant depths in the yellow sand, sometimes upon or under filmings of stratification, by Professor Wright and Dr. Hollick, Professor Smock, Messrs. H. B. Kummel, G. N. Knapp and H. C. Mercer.

under 'A' and 'B;' the first representing the preliminary spading, the second the shoveling.

The objects consisted of fire-cracked stones; unworked pebbles, from size of a cobble to that of a robin's egg; chips and flakes, mostly of chert, but a few of argillite; rejects; imperfect implements; a fragment of anthracite coal; a cinder; a piece of oyster (?) shell; a piece of modern pot-

1. Disturbed surface soil, consisting of fine yellowish-brown sand and black carbonaceous matter, giving it a prevailingly dark color, 8–12 in.

2. Undisturbed fine yellowish sand, irregularly stratified, with streaks of red sandy clay carrying small pebbles, 2 ft. 6 in.

3. Floor of red sandy clay at bottom.

The line of demarkation between the disturbed surface soil and the undisturbed

sand could not be sharply drawn. Streaks and small pockets of black soil often extended down irregularly into what was apparently undisturbed sand. A zone was therefore recognized, below the disturbed surface soil, which we agreed to call the 'zone of doubt.' All implements or objects found in this zone were listed under 'C.' The bottom of the 'zone of doubt' was about 18 in. below the surface of the ground.

Below the bottom of the 'zone of doubt' we agreed that the sand was undisturbed by human agency and that any objects found there must be regarded as having been deposited at the same time with the sand, or possibly intruded from above, in which case some evidence or indication of such intrusion should be apparent.

The following method of investigation was then pursued:

One person entered the pit and gradually cut away the face with a trowel. As soon as any object was struck the rest of the party were notified and the sand around it was carefully removed. The distance from the bottom of the 'zone of doubt' to the object was measured and the object was then removed and examined. Each such object was immediately wrapped in a separate piece of paper, together with a memorandum of the facts in connection with it.

NOTES.

As far down as we dug we found roots of living trees, larva of June bugs (?), ants, and occasional disconnected spots or streaks of dark matter, which I took to be the remains of old decayed roots.

The undisturbed sand was found to be distinctly stratified and evidently a water deposit. Pebbles and gravel grains were not uncommon, especially in connection with the clay seams, and nearly all the chips and implements found were lying flat, although a few were more or less on edge.

Nothing but rough chipped implements (palæoliths?) and fragments were found below the 'zone of doubt' up to the time when I left (4 p. m., Saturday, June 26th), when about one-half of the main excavation had been made.

Supplementary pits were also started close to the main excavation in order that others of the party might be occupied in digging at the same time. The methods employed were identical in each case.

We failed to verify the contention that only argillite chips and implements are to be found in the undisturbed sand. Some jasper, chert and quartz flakes were also found, but argillite was the most abundant material represented.

One fine chert implement was photographed in place. The details in regard to this and other objects found in the undisturbed sand are described by other members of the party.

CONCLUSIONS.

The writer accepts the conclusions of competent authorities that the so-called palæoliths are of human manufacture and that the sand in which they occur is of glacial age.

After a careful examination there seems to be no doubt that this sand is a water deposit and that it had not been disturbed by human agency prior to the time when it was excavated by our party.

The only controversy which seems possible is over the question of intrusion from above and, in view of the facts now adduced, the burden of proof should in fairness rest with those who hold this view.

ARTHUR HOLLICK.

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*DIVERSITY OF LANGUAGES.**

THAT type of civilization cannot be regarded as ideal or forethoughtful which

*Concluding section of the address on 'Improvident Civilization' by the Vice-President of Section I., Social and Economic Science, American Association for the Advancement of Science, Detroit, 1897.

tolerates a wide diversity of tongue in which to conduct its business or store up its ideas and valuable records. As already stated, difference of speech and writing tends to keep nations and races estranged, and so makes for war rather than peace. The only progress toward a uniformity of mother tongues now visible is by the slow and fitful process of political absorption by conquest or by trade. Singularly enough the acknowledged languages of learning, the Latin and Greek, seem to be losing rather than gaining their hold upon the best literature. This is not altogether a misfortune; for languages grow and expand to conform to the ideas of those who use them; and the original connotations of words are lost in their adaptations to new conceptions. In spite of the attempt to uphold the Roman tongue by the medical and priestly professions, it is no longer that spoken by Cicero. The English of to-day differs widely from that of Chaucer. But few famous treatises in science, philosophy, history or even theology are now written in Latin; other tongues command more readers, and it no longer so well serves as a vehicle for modern ideas. No language can escape this fate. The English, which is conceded by competent observers to be as rich, as flexible and precise as any of the great European tongues—though not as simple and symmetrical as some others—has embalmed in it quite as many of the indispensable works of the world, and has besides the suffrages of a hundred and twenty millions of people to whom it is vernacular, is nevertheless susceptible of great rectification, especially in the matter of pronunciation, spelling, and in the irregularity of the verbs. The testimony of Professor Merz, in writing of 'Scientific Thought in the 19th Century,' although strangely oblivious of American contributions, as such, uses the following language, after referring to the decaying use of the classics:

"The largest number of (Scientific) works perfect in form and substance, classical for all time, belongs probably to France; the greatest bulk of scientific work probably to Germany, but of the new ideas which during the century have fructified science the larger share belongs probably to England. Such seems to be the impartial verdict of history. During the second half of the century a process of equalization has gone on which has taken away something of the characteristic peculiarities of earlier time. The great problems of science and life are now everywhere attacked by similar methods. Scientific teaching proceeds on similar line, and ideas and discoveries are cosmopolitan property. So much more interesting must it be for those who have been born members of this international republic of learning to trace the way in which this confederation has grown up, what have been the different national contributions to its formation, and how the spirit of exact science, once domiciled only in Paris, has gradually spread into all countries and leavened the thought and literature of the world."

Nevertheless the hope of establishing either Latin or Greek as alternative world-languages, of learning, has not been abandoned among the classically educated; but all expectation of seeing the former generally adopted, at least as a spoken tongue, must have passed. If the great start of the Roman Empire, and the subsequent extension of its speech over a larger empire by the Church, did not suffice to give it precedence the chances are much against it now. Like the Roman jurisprudence it lives chiefly in its offspring. It has been more or less engrafted on the native tongues; itself is practically a dead language. The Greek survives among living tongues, but has only a limited field as such. In scientific and classical education, and notably in nomenclature, it has a future of utility as an enricher. Some of the international medical conferences are, I believe, ready to adopt it as an alternative language for their limited uses.

Meantime the business of the world becomes more and more international and interlingual. The spread of telegraphs by land and under seas, the extension of steam-

ships and steam railways across frontiers, sometimes across several of them, not only crowd the nations together, but some common code of communication between them is a desideratum—the world of commerce no less than that of letters and research waits for it. Regulation for navigation on the high seas have been contrived by the maritime nations and adapted to all; we have likewise a growing communication and conformity in astronomical, chemical and electrical literature; uniformity of standards of weight and measurement, mechanical devices and the like. In a small way, too, we have a universal language in musical notation; in the telegraphic alphabet, in the deaf-mute and in algebraic signs. How much longer will the international requirements of the whole world have to wait before a real world-language is hit upon? Must we wait until the struggle for political boundaries of the dozen or twenty several nations of Europe has concentrated the smaller ones into one dominant prodigy? If not, when and how shall the movement be begun and carried out, and by whom? The time seems to be ripe for a practical consideration of these questions, and it concerns some association of learning to do so; and for several reasons the initiative would seem to be left with the Department of Social and Economic Science.

I need not enlarge upon the magnitude of the continuing loss from the present diversity of tongues, not only in the time and effort spent in acquiring several languages, when one beside the vulgar tongue might answer all purposes of education, if that other alternate tongue were common to the great civilized nations. The waste is still greater from the publication of researches, laws, treaties and records in several dresses, all of which must be consulted by the student who would keep abreast of the advance of knowledge. The shelves of our libraries are being piled high with books of all shades of usefulness and uselessness, and an extensive ransacking of bibliographies is required to master any given topic. The most of these have only ephemeral value, but this again adds to the burden. One good effect of an alternate language of learning would be the saving from this weary plowing of the sands; the truly classic works worth preserving would in a few generations be winnowed out and a lifetime would not be consumed in mastering the works of authors long superseded, but which, as they now stand mingled side by side, are indistinguishable. An *Index Expurgatorius*, by a scientific college *de propaganda fide*, is not in accord with modern notions, but it would be a great step in advance to have all science uttered in one language and reviewed in the same. When one thinks of the ten thousand volumes printed annually by the presses in English alone, one is tempted to sympathize with that Arabian Calif who ordered the great library of his time destroyed on the ground that it was either superfluous or heretical.

Observe, there is no suggestion to invent a new language such as Volapuk aspired to be. We all know languages grow by laws of their own, and are not run into a mold. They are, however, plastic and susceptible of enrichment and improvement by human contrivance. Instances are quite numerous where one tongue has supplanted another; and the example of two or more languages being taught and used concurrently is quite common. In fact, the task of imposing a second speech on a nation is much easier than that of imposing another religious cult, or a change of metallic money standards, either of which is still deemed to be feasible.

The growth of languages may be compared to the formation of common paths and roads through the primitive wilderness; at first following the trails of wild beasts; whenever a tree falls across the path it is deflected and so continues long after the

obstruction has crumbled away. The tendency to these deviations and doublings seems to be inherent. The French is about the only tongue which has an officially appointed guardian to keep it within orthodox lines; and it must be added that none needed it so much, or has so much to be done for it remaining. What is needed, and would seem to be practicable, is the application of modern methods equivalent to the work of the civil engineer among the time-worn paths—a leveling and alignment, the taking out of kinks and détours, and introducing great precision and definiteness. It is no greater task for our time than the change to the Julian calendar was for that, and is comparable with the proposition to divide the year into 13 months of days. I fear it is not the proper or congenial rôle for philologists and lexicographers whose task will come in at a later stage, in the perfecting and grafting upon the adopted alternate language. Thus far their special interest seems to lie in the diversity rather than the uniformity of tongues; and their very modest efforts to introduce a more regular spelling and pronunciation, though not entirely barren, are, by no fault of theirs, hopelessly slow of adoption. The chances of these reforms would be better if English could be adopted as a world-language; and if another were chosen they might be needless.

This Association is called upon from time to time to join in international conferences, to recommend or appoint delegates to such gatherings, and to pass upon their reports touching matters of nomenclature, classification and standards. The cause of learning has very much at stake in an extension of this same function to language. Other interests are also concerned, and whether these other interests—foreign commerce, diplomacy, telegraph or transportation—shall take the initiative, or leave it to others, there should be a joint action and representation. This subject is already attracting the attention of practical business men, who may be expected to move in the matter faster than the teachers and lexicographers. While writing, my attention has been called to an address by a business man to a Boston business club, advocating the use of English as a world language. A table quoted from Mulhall, showing the growth of the great European languages in the years 1801 to 1890, shows that the English has increased 217 per cent., while no other except the German has reached so much as 100. I have added to it a column of estimated numbers, using the same tongues at the present time, in which the lead seems to be with the English, though this is liable to be challenged by the partisans of Russia, as the official language, though not the native one, of a nearly equal number.*

Can we assume that this lead can be maintained for another century, when the Russian Empire shall touch the two oceans and the Mediterranean, or when the German Empire shall extend from the North Sea to the Bosphorus? If not, there is nothing to be lost, and much to be gained, for us, by an earlier rather than a later settlement of this queation.

There have also appeared in the daily press expressions from some learned society of Germany, which I am expecting to see authenticated any day, a willingness on

*INTERLINGUAL CONFERENCE.

Mulhall's Table of increase, 1801–1890. (% in 1801.)	(% in 1890.)	Millions spoken by in 1895. (Estimated.)	
12.7	27.7	English	120.
19.4	12.7	French	46.
18.7	18.7	German	37.
9.3	8.3	Italian	32.
16.2	10.7	Spanish	22.
4.7	3.2	Portuguese	15.
19.	18.7	Russian (?)	129.
100	100		
		Scandinavian	9.
		Holland	5.

their part to adopt the English as an alternate world language, provided some necessary reforms were made in spelling and orally to make it more phonetic and conformed to the classic Latin and Greek. This is a very reasonable and fit concession to be imposed, and ought to be undertaken in our own behalf without regard to the propaganda. If, by some such concessions as these, the support of Germany, and perhaps also Holland, Scandinavia and Spain, can be won, the adoption of the English is assured; and we cannot too soon convene an international conference. The Germans are handicapped by a Gothic eye-destroying alphabet and an unmusical vocal speech, and are conscious of it. This is their opportunity and ours. The claim of the French as the established language of diplomacy is recognized in Europe, but, declining even there, would be outweighed even though supported by Russia. Opposition would be likely to come from that quarter, if from any; or from a possible coalition of all the rest against the leader. But fortunately this is a case in which there is no compulsion. No nation need be bound by any recommendation of the conference, if it thought it could do better to stand out. In brief it is the counterpart of the decimal metrical system; the advantages and drift of any action would be toward uniformity sooner or later. Professor Mahaffy is out in a very pronounced opinion as to the need of rectifying English; while Mr. Havelock Ellis, I perceive, is quoted as favoring French as a second choice.

My own idea about the manner of calling, and the composition of, such an interlingual conference is that, by virtue of her much greater foreign commerce, marine interests, including telegraph, postal, consular and diplomatic intercourse, the initiative would properly belong with the mother country. Any such call from her would be sure to suggest some antagonism, and, most likely, also she would be asked to content herself with one vote on behalf of Britain and all her colonies, and attempt might be made to link in the United States. I have no idea that representation according to aggregate population would be acceptable. The most feasible plan will be by nations, or groups of nations, the offshoots and colonies not being reckoned, except in the single case of the United States, which, if expedient, could speak for Canada, too. The position of North America is one of peculiar freedom from jealousies and entanglements, and if the mother country will for this occasion graciously let her full-grown settled daughter appear in the foreground there will be less friction to encounter, and the result will be the same in either case.

There is a certain fitness aside from its expediency. American lexicographers and philologists have done more for the improvement of English in a hundred years than the British. Besides, the number of universities and students and the literary output are now comparable in volume, if not in quality, with the older nation. The ultra-conservatism of British publishers is shown by an unwillingness to handle books by American authors using the abridged spelling of certain common words where the right of argument is on our side. Again, in Asia, especially in China and Japan, which are now open to Occidental literature, science and arts, we are side by side with the British and opposed by French and German influences. If I am rightly informed, Japan is most anxious for uniformity; in fact, would accept readily a common tongue, and prefer the English. The part to be played by these islanders of the far East in international affairs cannot yet be defined, but their alliance in these bonds of peace, civilization and learning is worth cultivating.

As a rough outline of the composition of

the first conference on an alternate common language for international trade intercourse, letters, science and arts, let us suppose that whenever a sufficient number of avowals of interest in the subject shall have been received from representative bodies an invitation shall be addressed by the Secretary of State of the United States, or by this Association, or some similar body, to like associations and guilds in the following countries to choose delegates to meet at some suitable time and place in central Europe:

1. Great Britain, including colonies and India.
2. United States of America and Canada.
3. Germany, not including Austria.
4. Austria and the Hungarian and adjacent Slav states.
5. France including her colonies and Belgium.
6. Spain and Portugal.
7. Italy.
8. Greece.
9. Holland.
10. Scandinavia (Denmark, Sweden and Norway).
11. Russia.
12. The Spanish and Portuguese republics of North and South America.
13. Japan (by courtesy, not voting).

Each of these units to be represented by, say, five delegates drawn respectively from the larger international interests:

A. Political—diplomatic and jurisprudence.
B. Scientific—mechanical and medical.
C. Foreign commerce and navigation.
D. Telegraphic, foreign exchange and postal.
E. Pedagogy, publishing and philology.

Here we may have a polyglot convention of say sixty-five persons, with sixty votes representing various pursuits. All that it need do is to pass resolutions, after preamble, recommending to their respective governments that it be made lawful on and after a certain date, say January 1, 1901, or as soon thereafter as may be, to use the language adopted, and that it shall be taught in all public schools as a second, or alternating, language; and further that all documents for interlingual use, such as passports, cable and telegraph blanks, navigation charts and astronomical codes, postage stamps, money orders, letters of credit, coins, tables of metric systems, shall be inscribed in both media. Similar action on the part of the guilds and institutions themselves would be sufficient to ensure the trial.

The work of simplifying the adopted tongue, so as to make it more acceptable and more easily acquired by the rest is quite another function, belonging to a different body, and can be reported on from year to year without limit of time. Our newest dictionaries contain already some thousands of minor and acceptable changes. It would greatly add to the regularity and euphony of the English (if it should be chosen) to incorporate and substitute freely from the Spanish as written (not, however, including the eccentricities of its pronunciation) in which case the Latin and Italian methods should be taken; in this way the good will of our neighbors on the American continent might be secured, with no detriment whatever to ourselves. Computations are sometimes made to show the enormous aggregate loss from the use of redundant or silent letters in writing and typesetting. This economy is easily embraced within the larger reform outlined above.

If it is the pleasure of the Section, during this meeting, to take any action on this subject, it will give us pleasure to urge it before the Council.

RICHARD T. COLBURN.
ELIZABETH, NEW JERSEY, U. S. A.

APPENDIX.

The following resolution was subsequently adopted by the Council, and copies ordered printed for corresponding societies, universities, etc.:

WHEREAS this Association is from time to time called upon to recommend or choose delegates to international conferences seeking to promote uniformity in scientific classification nomenclature, metrology, publications, and is likewise interested in uniformity of navigation and postal regulations, and researches

at present recorded in several differing European languages; and

WHEREAS the diversity of tongues is a continuing hindrance to interchange of knowledge and literatures, seriously enhancing the cost and labor of studious pursuits, which might in large measure be avoided by the adoption by the civilized nations of an Alternate Language of Learning, Law and Commerce, and as such required to be taught in higher schools (in combination with the mother tongue) and used in interlingual correspondence and printed records; and

WHEREAS it is believed this need is felt and acknowledged by societies and corporations of several nations and awaits the initiative of some one of them to propose concerted action thereon; now, therefore, be it

Resolved, That whenever the President or Permanent Secretary of the Association shall have received from similar bodies, or from universities of Europe, expressions sufficient in number to represent a majority of the maritime peoples, signifying a desire to cooperate in an International Conference of Languages, it shall be his duty to lay the same before the Council at the next regular, or, if neeed be, at a specially-called, meeting, with the view to the appointment of one or more delegates to represent American Pedagogy and Science thereat, at some convenient time and place in central Europe.

In like manner the Permanent Secretary is hereby authorized to acknowledge, on behalf of this Association, receipt of such invitation for a like purpose emanating from any government, or department thereof, Institution of Learning, Technical Science, Chamber of Commerce or Finance, Telegraphic or Transportation Bureau, Postal Union or Academy of Arts and Letters, and to pledge the further attention of this Council to the same.

GEOLOGY AND GEOGRAPHY AT THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

PROFESSOR I. C. WHITE, Chairman of the Section, being in attendance upon the International Geological Congress in Russia, the Council filled the vacancy by the election of Professor E. W. Claypole, who read Professor White's address and presided over the meetings of the Section.

After the presentation of the vice-presidential address, the following papers were read:

1. 'The Geological Age and Fauna of the Huerfano Basin, in Southern Colorado,' by Professor H. F. Osborn, New York. The author reviewed the work of R. C. Hills, and concluded from recent field work that the Huerfano Lake deposits are from 800–1000 thick, consisting of upper beds equivalent to Bridger, and lower beds equivalent to Wind River and Wasatch. Below them is an unconformable series, probably Cretaceous. The distribution of deposits indicates a different extension of the lake from that given by Hills. Brief reference was made to the fossils found.

2. 'Lake Chicago and the Chicago Outlet,' by Frank Leverett, Denmark, Iowa. The paper discussed, in detail and with abundant data, the beaches and outlet of Lake Chicago, a glacial lake having southward discharge from the southern end of Lake Michigan basin, through the Des Plaines and Illinois rivers to the Mississippi.

3. 'Some Features of the Recent Geology Around Detroit,' by Frank B. Taylor, Fort Wayne, Ind. Detroit is built on moraines deposited under 200 feet of water. While the ice front was here the western half of Erie basin was filled by a glacial lake. This gives a very smooth surface contour. Shore lines and beaches are well developed. The lower courses of old tributaries of Detroit river are drowned. Streams two miles long have deep estuaries, much deeper than they could erode under present conditions, *e. g.*, Rouge River and Baby Creek. Rouge River, four miles above its mouth, has an average mid-stream depth of from 20 to 30 feet, four times deeper than would be expected from the stream's own erosion. The same is true of the St. Clair tributaries. The succession of events has been as follows: The rivers first flowed as now, but slightly higher. Then, while the upper lakes drained to the Ottawa, abandoning the St. Clair and Detroit Rivers, the streams were cutting to a base level from 25 to 30 feet lower than present river surface. Finally, a northeast uplift established existing conditions

and the refilled Detroit and St. Clair backed up into the deepened tributaries. This confirms the previously supposed temporary drainage of the upper lakes to the Ottawa.

4. 'The Lower Abandoned Beaches of Southeastern Michigan,' by Frank B. Taylor, Fort Wayne, Ind. The paper described the characteristic features, altitudes and deformations of the beaches, and showed that there are at least four important beaches at the south end of Lake Huron, below the Forest Beach of Lake Warren. Two of them, the Elkton and Algonquin, probably extend as far south as Detroit, though not yet traced to this place. The Nipissing beach is supposed to pass under Lake Huron at the south end.

5. 'Recent Earth Movement in the Great Lake Region,' by G. K. Gilbert, Washington, D. C. A comparison of gauge records and bench marks, representing a period of about twenty years, shows that, in the lake region, the land is being tilted from northeast to southwest. The rate is such that of two points one hundred miles apart the northern rises five inches with reference to the southern, in a century. At Chicago the mean lake level is rising at the rate of one inch in ten years. On account of the slight elevation of the divide between Lake Michigan and the Illinois River, a comparatively small tilting of the region will establish an outlet in this direction. It is estimated that, in about three thousand years, all of the upper lakes will discharge into the Illinois River, the current of the Detroit and St. Clair Rivers will be reversed, carrying the water of Lake Erie into Lake Huron, and the Niagara River will run dry.

6. 'A Supplementary Hypothesis of the Origin of the Loess of the Mississippi Valley,' by Professor T. C. Chamberlin, Chicago, Ill. The paper opens by a statement of two great features of the distribution of the loess of the Mississippi Valley which are significant of its origin: (1) The loess is distributed along the leading valleys; (2) it is distributed along the border of the former ice sheet at the stage known as Iowan. These two features indicate the relationship of the loess to the great drainage valleys and to the ice sheet. Nevertheless, the vertical distribution of the loess and the presence of land shells offer great difficulties in the way of accepting the pure aqueous theory. After sketching these difficulties the paper proceeds to offer a hypothesis, which divides the honors between the aqueous and the Eolian agencies. Recognizing the strength of the arguments in favor of a glacio-fluvial origin, it postulates the limitation of the aqueous loess to the lower levels and assumes that the oscillations in the flood stages gave rise to broad, exposed flats, which when dry would be swept by the winds and the dust derived, carried to and lodged upon the uplands, giving rise to an eolian phase of the loess. The paper proceeds to discuss the necessary accommodation between the extent of the aqueous and the fluvial depositions and to compare the combined hypothesis presented with that of Richtofen.

7. 'An Account of the Researches relating to the Great Lakes,' by Dr. J. W. Spencer, Washington, D. C. The author presented an exhaustive review of the gradual development of our knowledge of the Great Lakes, stating the various opinions that have been, and are now, held in regard to their origin, changes and probable future. Being in itself largely a summary, the paper scarcely admits of condensation to the limits of a brief abstract.

8. 'Changes of Level in the Glacial Formations of the Alps,' by Professor Albrecht Penck, Vienna, Austria. The deposits belonging to the glacial period of the Alps must, as to their origin, be divided into true moraine and fluvio-glacial. The moraine deposits occur everywhere where glaciers

have existed, and are not confined to certain levels. The fluvio-glacial gravels, as river deposits, must have had originally a slope in the direction in which the river flowed. This slope has been in some places destroyed by earth movements. This can be shown in the best way by following the oldest of the three fluvio-glacial deposits, the high-level gravel. It formed originally an extensive covering of the low ground of the north Alpine Piedmont region, sloping to the north. Now it forms a series of very flat folds which run parallel to the foot of the western Alps. These folds can be followed from the mouth of the Aar into the Rhine, and from the mouth of the Lech into the Danube, a distance of 250 miles.

The earth movements of the glacial period in the Alps are of a different type from those about the grand American lakes. The American belong to a warping of the earth's crust, which is independent of structural lines; the sub-Alpine shows that the folding of the Alpine system was still going on in early glacial times in the foreland. Whether or not this folding was connected, as Heim assumes, with a bodily sinking of a whole mountain chain, could not be ascertained.

9. 'A Suggestion in Regard to the Theory of Volcanoes,' by Professor W. N. Rice, Middletown, Conn. The distribution of volcanoes gives a clue to their cause. As a generalization, it may be stated that volcanoes occur in localities where there has been recent elevation. Assuming the interior of the earth to be potentially liquid, relief of pressure by crustal uplift might cause fusion, the fused material finding exit by fissures produced during the movement. This idea has been suggested before, but seems deserving of the more explicit formulation presented in this paper. To the objection that contemporaneous sheets of igneous rocks occur in thick masses of sediment, indicating subsidence, it may be answered either that igneous rocks come from adjacent rising areas or that they point to oscillation of movement, progressive subsidence being interrupted by epochs of elevation.

10. 'The Ores and Minerals of Cripple Creek,' by H. P. Parmelee, Charlevoix, Mich. After a short review of the rocks and ores of the region, the important minerals were mentioned, and some described in detail. Specimens of several species were shown, among them a very perfect crystal of calaverite.

11. 'Observations on the Genus Barrettia,' by Professor R. P. Whitfield, New York. The author referred to the original discovery of the fossils and description of the genus by S. P. Woodward, with its reference to the Rudistidæ; he then pointed out several peculiar features of the fossils not noticed in the original description and called attention to their strong resemblance to cup corals, and their general radiate structure. The description was based upon a large collection of specimens obtained from Jamaica, W. I.

12. 'Ice Jams and what they Accomplish,' by Dr. M. A. Veeder, Lyons, N. Y. The paper dealt with the effect of ice forced through river channels, partly floated and partly grounded on the land through choking of the outlets of lakes. The channeling of rock surfaces in the St. Lawrence valley and the formation of parallel ridges in Salina marls and shales were ascribed to this action.

13. 'The Lower Carboniferous of Huron County, Michigan,' by Dr. A. C. Lane, Houghton, Mich. This paper, read by Mr. W. F. Cooper, described the Bayport limestone, the Michigan salt group and the Marshall series, as exposed along the 'Thumb' of the Lower Peninsula. The localities were arranged in their proper position in the geological column, and it was shown that the rocks have a greater

thickness than was formerly supposed. Preglacial stream valleys were also treated.

In the absence of the authors the following papers were read by title:

14. 'Progress of Hydrographic Investigations by the United States Geological Survey,' by F. H. Newell, Washington, D. C.

15. 'Stylolites,' by Professor T. C. Hopkins, State College, Pennsylvania.

Tuesday was given to the Geological Society, and Wednesday afternoon the Section met with Section H, joining in the discussion of the human relics found in the Trenton gravel.

C. H. SMYTH, JR.

HAMILTON COLLEGE.

GEOLOGICAL SOCIETY OF AMERICA.

THE ninth summer meeting of the Society was held at Detroit, August 10th, under the presidency of Professor Edward Orton.

The Secretary announced the election of nine fellows.

The following papers were read:

1. 'The Granite Mountain Area of Burnet County, Texas,' by F. W. Simonds. The area described embraces about fifty square miles, from which the overlying strata have been removed, and the granite reduced to a plain, except at Granite Mountain and Johnson's Rock, which rise about one hundred feet above the general surface. The granite is a biotite granite and is quarried on a considerable scale, affording an excellent building material. After reviewing the opinions of Walcott, Hill and Comstock in regard to the age of the granite, the author concluded that the intrusion accompanied post-Carboniferous disturbances, and may have been as late as Cretaceous.

2. 'Stratigraphy and Structure of the Puget Group, Washington,' by Bailey Willis. The Eocene and Miocene strata adjacent to Seattle and Tacoma are folded and faulted in a manner closely analogous to that of the Appalachian region, but the compressing force acted from the west instead of the east. The fresh-water Eocene is much like the eastern Carboniferous, consisting of arkose sandstones and clay shales containing iron carbonate nodules, with beds of coal or black shale every one hundred, to one hundred and thirty, feet. The total thickness exceeds eight thousand feet. When slightly disturbed, the coal is lignite, but as the amount of disturbance increases there is a passage into steam coal with cubical fracture, and, finally, into coking coals. The coals, being planes of easy slipping, have greatly affected the folding, and have themselves often been crushed to powder.

3. 'The Loess as a Land Deposit,' by J. A. Udden. Observation indicates that the air is not depositing dust in sufficient quantities to build the loess, which spreads over such great areas, at elevations ranging from 300 to 3,000 feet. But the amount deposited varies greatly and may have been much larger in early post-glacial times. The loess closely resembles undoubted wind-blown deposits, while in its uniformity and prevailing lack of bedding plains it is quite different from most aqueous sediments. On the whole, the actual phenomena exhibited by the loess seem to accord better with the hypothesis of Eolian origin than with any other.

4. 'Analogy between Declivities of Land and Submarine Valleys,' by J. W. Spencer. With the aid of diagrams, the author pointed out the close resemblance existing between subaërial and submarine valleys, particularly in the Antillean region. He concluded that such similarity of topography must indicate a common origin, and that the present sea bottom must be a submerged land surface. This shows a sinking of ten to fifteen thousand feet in the Antillean basin, which was probably compensated by an elevation in the region of Mexico.

5. 'Great Changes of Level in Mexico, and the Inter-Oceanic Connections,' by J. W. Spencer. The geological basement of Mexico is a post-Cretaceous base level, out of which rise the higher mountains. A deep-water formation of Mio-Pliocene age rests unconformably upon the Cretaceous. These rocks, by their distribution, point to a Pliocene submergence, with 'canals' or straits connecting the Pacific and Gulf waters. This conclusion is further substantiated by the similarity of the shallow water faunas on the opposite sides of the isthmus, the deeper water forms being quite unlike. This connection was broken by a recent, almost modern, elevation, amounting, in some places, to 8,000 feet.

6. 'The Origin of the Gorge of the Whirlpool Rapids of Niagara,' by F. B. Taylor. From the falls to the cantilever bridge the Niagara gorge is broad. At the latter point it suddenly narrows, and the diminished width continues to within eighty rods of the whirlpool. From here to Lewiston it is wide again. The author ascribed the formation of the broad upper and lower gorges to the action of the great cataract carrying the entire discharge of the upper lakes. The narrow gorge of the whirlpool rapids was referred to a smaller cataract, when the three upper lakes were draining through the Nipissing into the Ottawa. Thus, the latter gorge, being cut by a comparatively small river, must have required for its formation a long time, probably not less than 20,000 to 25,000 years. This considerable period must, therefore, be reckoned with in estimating post-glacial time.

7. 'The Glacial Drainage of the Simcoe Area in Ontario,' by F. B. Taylor. In this paper the author gave reasons for believing that during a period when the Nipissing outlet was closed, a drainage channel was established from Georgian Bay through the River Trent.

8. 'Exposures near Detroit of Helderberg Limestone, and Associated Gypsum Salt, and Sandstone,' by W. H. Sherzer. The highest rocks exposed in southeastern Michigan are Upper Helderberg, nearly or quite equivalent to Corniferous. They are very pure limestones with chert beds, and have a thickness of 100–160 feet. Beneath them is a series equivalent to the Water-lime, chiefly drab dolomites, sometimes oölitic. Some distance below the top of the Water-line is intercalated a bed of white sand, almost pure quartz, many of whose grains show secondary enlargment. Extending to a depth of over 2,000 feet beneath Detroit is a series of beds of gypsum and rock salt, the latter aggregating a thickness of five hundred feet in three beds. Thus, Detroit possesses, in almost unlimited quantities, the pure limestone and salt which are the raw materials of the soda ash and caustic soda industry.

The following papers were read by title:

9. 'Notes on the Geology of the Lower Peninsula of Michigan,' by A. C. Lane.

10. 'The Nomenclature of the Carboniferous Formations,' by R. T. Hill.

11. 'Ice-transported Boulders in Coal Seams,' by E. Orton.

12. 'Clay Veins Vertically Intersecting Coal Measures,' by W. S. Gresley.

C. H. Smyth, Jr.

Hamilton College.

REGENERATION IN OLIGOCHAETE WORMS.

Professor T. H. Morgan, of Bryn Mawr, has made the following summary of recent studies upon regeneration in worms:*

1. Pieces of the anterior end of Allolobophora fœtida containing less than thirteen segments rarely, if ever, regenerate posteriorly, yet such pieces can regenerate very quickly anterior segments if these are cut off. The result shows that the lack of power of the anterior pieces to regenerate

* Archiv für Entwickelungsmechanik, V. Band, 3 Heft.

posteriorly does not depend, directly, on the size of the piece. 2. Anterior ends containing from thirteen (?) to thirty segments sometimes regenerate posteriorly, but only after a long time and in general, the shorter the piece (*i. e.*, the nearer the cut to the anterior end) the longer the interval before it begins to regenerate, and the fewer the pieces that regenerate at all. 3. Similarly very short posterior pieces do not regenerate anteriorly; longer pieces from the posterior end regenerate occasionally, but only after a long interval of time. In general the shorter the posterior piece the longer the time before the piece begins to regenerate anteriorly. 4. The experiments show that Weismann's hypothesis of latent cells is insufficient to explain the phenomena of regeneration, because it can not account for the delay in regeneration of a lost part under the circumstances given above. 5. Short pieces from the middle of the worm sometimes regenerate both anteriorly and posteriorly. 6. If a worm be cut in two pieces and then the anterior end be cut off again from the anterior piece, the middle piece will regenerate posteriorly at the same rate and time as though the anterior end had not been cut off. 7. If posterior ends of two worms be sewed together and if then one of the ends has a part cut off, the part that regenerates is like the part removed; *i. e.*, a new posterior end, and not a new head regenerates.

The power to regenerate is, in some cases, of the greatest use to an animal since it enables the animal, if injured, to reproduce the lost parts. It is, therefore, surprising to find the phenomenon of regeneration almost entirely neglected by the advocates of the theory of natural selection. Darwin scarcely alludes to the matter and most of his followers make little or no reference to the subject. Weismann, however, in his recent book on the Germ Plasm has opened up the question. A quotation will serve to show how successfully he has treated the matter from the selectionists' standpoint. "The power of regeneration in any particular part cannot depend only on the conditions which exist as regards the species under consideration; it must also be due to arrangements for regeneration which have been transmitted by the ancestors of the species. Leaving the question aside, and regarding the power of regeneration as merely depending in each individual case on adaptation, we should arrive at some such conclusion as the following: the provision of the cells of a certain part with supplementary determinants for the purposes of regeneration depends primarily on the liability of this part to frequent injury * * * * a useless or almost useless rudimentary part may often be injured or torn off without causing processes of selection to occur which would produce in it a capacity for regeneration." How an infinite number of injuries to a part could ever produce in it a capacity for regeneration is far from clear. Injured animals would be, on the whole, at a disadvantage in the struggle for existence; if some of them have the power to regenerate already they are neither better nor worse off than those that have not been injured. Just how injured animals would ever be able in each generation to obtain an advantage over uninjured animals is by no means self-evident. In my experiments, for instance, I find that only rarely do posterior ends of worms cut in the middle regenerate anteriorly, and even in those cases where this happens the regeneration is almost always imperfect. Does this mean that as yet an insufficient number of these worms have been injured in this way? In the course of time if more worms are injured by accidents, will Allolobophora fœtida acquire a capacity for regenerating the anterior end? Are we to consider seriously this interpretation of the selection theory?

THE SURVEY OF THE FOREST RESERVES.

Professor Chas. D. Walcott, Director tor of the United States Geological Survey, has just returned to Washington after an absence of three months and a-half spent in the field.

In the course of his journeys Mr. Walcott gave a short time to geologic investigation in the Sierras, on his own account, and to attending to the general affairs of the bureau. He was engaged principally, however, in looking after the surveys and investigations of the suspended forest reserves, a work only just entered upon by his bureau, and to start which Congress at the last session made an appropriation of $150,000. This work was started and got under way in July. In connection with this branch of work topographic and subdivision surveys are being made in nine of the forest reserves of the West, the field being divided between two of the topographic divisions or sections of the Survey. Mr. R. U. Goode, of the Pacific Section, is making surveys in the Bitterroot, the Priest River and the Washington reserves, while Mr. Douglas, of the Rocky Mountain Section, is surveying the Lewis and Clarke and the Flathead reserves of Montana, the Big Horn and Téton Reserves of Wyoming and the Uinta Reserve of Utah. Before the season closes Mr. Goode will also work in the San Jacinto Reserve of southern California, sending some of his parties into that area when they are driven by bad weather out of the more northern reserves.

Data on which to base definite statements of the results of the surveying work of the season are not yet available. Preceding the topographic work proper triangular and spirit-level lines are being run, except in the higher and more rugged regions, where there are no roads and trails. The subdivision surveys are being made in the same manner as the subdivision surveys in Indian Territory. Another feature is the outlining by the surveyors, in the course of their other work, of all wooded and forested areas, and another is the erection, at suitable intervals, of permanent bench marks, to mark the elevation above sea level. There are from one to three parties in each reserve. It is yet too early for definite statements of the results of the season's work, but such data as are at hand indicate that the surveys have progressed satisfactorily, considering the lateness of the start, the rugged character of much of the country traversed, etc. In the Washington and Flathead Reserves work was discontinued at the close of September on account of snow and otherwise unfavorable weather, but at last reports it was still going on in all other localities.

The topographic maps which will result from the topographic surveys will be on the scale of two miles to the inch with 100 foot contour intervals. These will serve as base maps for the representation of forestry details, agricultural and mineral lands, etc. The subdivision surveys will enable the demarkation of tracts of land for agriculture, for minerals and for timber.

The general economic investigation of the reserves is under the charge of Mr. Henry Gannett, who is assisted by seven forestry experts. The reserves, and the experts assigned to each, are the Black Hills Reserve, H. S. Graves ; the Big Horn Reserve, F. E. Town; the Priest River Reserve and the eastern part of Bitterroot Reserve, John B. Leiberg; the eastern portion of Washington Reserve, W. Y. Steele and M. W. Gorman ; the western portion of the Washington Reserve, H. B. Ayers, and the Téton Reserve, Dr. T. S. Brandegee. Work was begun in these several reserves at various dates between July 1st and August 15th. It has since progressed satisfactorily in all the reserves, according to Mr. Gannett, who has just returned to Washington and made his first report of the season. The first area to be completed, Mr. Gannett says, is the

Priest River Reserve, which was finished about the end of July; the second the Téton, finished about the middle of September. The Big Horn Reserve is practically completed at this date. Work in the other areas is still in progress, or was when Mr. Gannett reported.

The information obtained by Mr. Gannett's division touching these reserves relates to the condition, value and character of the timber; the density of undergrowth; the prevalence of fires in past times; the extent of cutting; the location and extent of lands more valuable for other purposes than for timber; the amount of settlement within the reserves, and the demand for timbers in their neighborhood. It is expected that the results obtained will be of value to the government in delimiting the boundaries of the reserves and in their future administration.

W. F. MORSELL.

WASHINGTON, October 20, 1897.

CURRENT NOTES ON ANTHROPOLOGY.

MAYA DAY SYMBOLS.

IN the 'Sixteenth Annual Report of the Bureau of American Ethnology,' Professor Cyrus Thomas has an elaborate article of sixty pages on the day symbols of the Maya year. In this study he follows the list of days as given by most authorities, beginning with *imix.* After quoting the names assigned them in five of the seven languages where this calendar was in use, he comments upon the meaning and relationship of the various terms. He departs in frequent instances from the opinions of earlier writers, but in the main agrees that in a general way there exists a connection between the terms used to designate any one day.

He has taken pains to point out in several passages some similarities in the meaning of the day-names to superstitions found among the Polynesian islanders. These are somewhat striking, but scarcely so much so as the similarities long ago pointed out between the Mexican and certain Eastern Asiatic calendars by Alexander von Humboldt. They are such as may be found the world over when we compare early attempts to measure time for religious or divinatory purposes.

The paper is abundantly illustrated, and will prove a useful work of reference to the student of Mayan hieroglyphs.

THE VIKING CLUB.

THE voyages of the Northmen to America excite an interest in their ancient memorials among American scholars. All such will welcome the periodical issued by the Viking Club under the name of *The Saga-book.* Its aim is to concentrate the study of Norse mythology, history and literature. Especial attention is given to ancient inscriptions on stone or other material exhibiting the runic and symbolic figures of the early script. The extension of the Norsemen through Scotland and Ireland was accompanied by a large amalgamation of Celtic elements. It has been shown that this reached by transmission to Iceland, where we find a considerable number of ancient Celtic names.

The *Saga-book* is handsomely printed and illustrated and may be bought of the publisher, David Nutt, London. The club itself is founded as a social and literary society for all interested in the North and its literature and antiquities. Meetings are held in London from November to June. It aims to found a library, to present and discuss papers on Northern antiquities, to encourage the publication of documents, arrange for exhibitions, etc. The subscription is ten shillings yearly, which entitles to a copy of the 'Proceedings.' Applications may be sent, care of the publisher, 270 Strand.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

BOTANICAL NOTES.

A MODEL NATURAL HISTORY SURVEY BULLETIN.

A FEW years ago the State Botanist of Minnesota began publishing botanical papers bearing upon the botany of his State in periodical bulletins under the name of 'Minnesota Botanical Studies.' These have attracted wide attention as well from the matter which they contained as the manner of their publication. The State law under which the natural history survey is conducted provides for the immediate publication of scientific contributions in the form of bulletins, in advance of the annual report, and this wise provision has enabled the State Botanist to conduct the unique publication referred to above. The first number was issued in January, 1894, since which ten more numbers have appeared, covering 1,043 pages, accompanied by eighty plates, and including fifty botanical papers. The wide range of these papers may be seen from the following synopsis :

	No. of Papers.
Morphology	1
Histology	1
Physiology	14
Phytogeography	7
Algæ	5
Fungi	4
Lichens	3
Liverworts	1
Mosses	6
Flowering Plants	7
Slime Moulds	1

Among the titles are the following: 'On the occurrence of Sphagnum atolls in Central Minnesota,' 'A revision of the Mucoraceæ with especial reference to species reported from North America,' 'A preliminary list of the mosses of Minnesota,' 'Titles of literature concerning the fixation of free nitrogen by plants,' 'A contribution to the bibliography of American Algæ,' 'On the distribution of the North American Helvellales,' 'A rearrangement of North American Hyphomycetes,' 'Contributions to a knowledge of the lichens of Minnesota,' 'The alkaloids of *Veratrum.*'

A comparison of the foregoing titles and subjects with those which commonly fill the pages of the publications of other natural history surveys justifies us in regarding this bulletin as a model which might profitably be followed in other States.

THE USEFUL FIBER PLANTS OF THE WORLD.

THE United States Department of Agriculture has recently issued a most useful nd interesting descriptive catalogue of the useful fiber plants of the world. It was compiled by the well-known statistician, Charles R. Dodge, and is the result of many years of labor. It includes 1,018 fibers alphabetically arranged, and illustrated by 102 cuts and twelve half-tone plates.

In the treatment of each fiber a brief description is given of the plant from which it is derived, and this is followed by a description of the fiber and the operations by which it is prepared for use. In cases of the more important fibers further details are given as to cultivation, preparation for the market, commercial statistics, etc.

The introductory chapter includes some interesting sections, that upon the principal fibers used commercially in the United States being especially noteworthy. From it we learn that about thirty species are used in this country, and that with the exception of the Cabbage Palmetto (*Sabal palmetto*), the Saw Palmetto (*Serenoa serrulata*) and Spanish Moss (*Tillandsia usneoides*), we are still more or less dependent upon foreign growers for our supply. Thus of the more common fibers, flax is imported from Belgium, Russia, Holland, Italy, Great Britain and Canada ; hemp, from Russia, France, Belgium, Germany, Austria-Hungary, Italy and the Netherlands ; jute, from India ; cotton, from Egypt and Peru ; raffia, (used for tie bands), from Africa; sisal

hemp, from Yucatan; manilla hemp, from the Philippine Islands, etc.

Two classifications of fibers are presented, structural and economic.

The first is as follows:

A. FIBRO-VASCULAR STRUCTURE.

1. *Bast fibers* (of dicotyledons).
2. *Woody fibers* (of dicotyledons), from (*a*) twigs and small stems, used entire, (*b*) roots, (*c*) trunks split or cut into layers or splints, (*d*) trunks ground into pulp.
3. *Structural fibers* from (*a*) the isolated fibro-vascular bundles of the leaves and leaf stalks of monocotyledons, (*b*) the whole stems, roots or leaves of monocotyledons, (*c*) the fibrous portions of the leaves or fruits of certain dicotyledons.

B. SIMPLE CELLULAR STRUCTURE.

4. *Surface fibers*, including (*a*) hairs on seeds, (*b*) hairs from stem surfaces, and (*c*) epidermal strips from leaves, as of certain palms.
5. *Pseudo-fibers*, including (*a*) certain mosses, as species of sphagnum, (*b*) certain seaweeds used for packing, (*c*) certain seaweeds for cordage, (*d*) the mycelium of certain fungi.

Economically, fibers are classified as follows:

A. *Spinning fibers*, including (1) fabric fibers, (2) netting fibers, (3) cordage fibers.

B. *Tie material.*

C. *Natural textures*, including (1) tree basts with tough interlacing fibers, as in the 'lace barks,' (2) ribbon or layer basts, (3) interlacing structural fibers or sheaths, as cocoanut sheaths.

D. *Brush fibers*, including (1) prepared fibers from isolated fibro-vascular bundles, (2) fibers from roots, flower pedicels, etc., (3) twigs and splints.

E. *Plaiting and rough weaving fibers*, including those used for (1) making hats, sandals, etc., (2) matting, thatching, etc., (3) baskets, (4) chair-bottoms, etc.

F. *Various forms of filling*, as (1) stuffing for chairs, cushions, mattresses, etc., (2) caulking, (3) stiffening, *e. g.*, in the manufacture of 'staff,' (4) packing.

G. *Paper material*, for making (1) textile papers, (2) bast papers, (3) palm papers, (4) bamboo and grass papers, (5) wood-pulp papers.

CHARLES E. BESSEY.
THE UNIVERSITY OF NEBRASKA.

SCIENTIFIC NOTES AND NEWS.

REPORT OF THE SECRETARY OF AGRICULTURE.

THE Secretary of Agriculture has presented to the President his report reviewing the work of the Department for the past year. The conduct of the Department under Secretary Wilson has greatly advanced the economic and scientific study of agriculture and the conditions on which agriculture depends, and the recommendations of his report will consequently carry much weight.

Mr. Wilson proposes that agents for the Department should be stationed at each of the important American legations abroad for the collection of information of interest to American farmers. The Department is endeavoring to get information from foreign countries with which to compete in the markets of the world regarding crops and prices, and is also taking steps to ascertain what crops are grown on different thermal lines, so that seeds and plants may intelligently be brought to this country to assist in the diversification of our crops and add to their variety. There is a necessity for American agents, educated in agricultural science, in every foreign country to which are sent reports.

Mr. Wilson recommends an increase in the appropriations in aid of the Bureau of Animal Industry, of the Weather Bureau and of the publication offices. He thinks the Department should be enabled to place the results of important operations at agricultural colleges before the entire country, so that the farmers of each State may benefit from the work done in

other States. The present method of securing crop reports is criticised, and the employment of a statistical agent in each State with paid reporters is recommended.

Mr. Wilson not only believes that the exports from America can be greatly increased, but that nearly all the imported agricultural products, valued at $400,000,000, could be and should be produced at home.

THE GEOLOGICAL SURVEY OF WEST VIRGINIA.

AT the last session of the Legislature of West Virginia an act was passed establishing a State Geological and Economic Survey, to be under the direction of a commission consisting of the Governor, State Treasurer, President of the State University, Director of the Agricultural Experiment Station, and President of the State Board of Agriculture. Three thousand dollars a year was appropriated to carry on the work. The act is similar to that establishing the Geological Survey of Maryland, in which the corporation of the Johns Hopkins University was secured and the Survey inaugurated in a manner so promising for science and economic usefulness.

The commission of the West Virginia Survey met in Wheeling last month and organized, electing Governor Geo. W. Atkinson President; Mr. M. A. Kendall (State Treasurer), Treasurer; Professor T. C. Atkeson (President of the State Board of Agriculture), Secretary; Mr. J. H. Stewart (Director of the Experiment Station), Superintendent of the Department of Economic Biology; and President Jerome H. Raymond (West Virginia University), Executive General Officer. Dr. I. C. White was elected Superintendent of the Survey. He is in Europe now, and it is not yet known whether he will accept, but he will return soon, and then the real work of the Survey will begin. Professor S. B. Brown, professor of geology in the University, was elected First Assistant Geologist and Curator of the Collections. Professor J. L. Johnston, professor of civil engineering, has been appointed Assistant Geologist, with the special duty of locating the meridian lines of each of the county seats of the State. The headquarters of the Survey are at the West Virginia University, Morgantown.

THE NEW YORK ZOOLOGICAL PARK.

A LETTER from Mr. William Hornaday, Director of the New York Zoological Park, published in the *Critic*, calls attention to a fact perhaps not known to those who have objected to increasing the attraction of the park lands north of the Harlem River by using a small part of them for botanical and zoological gardens. Mr. Hornaday writes:

"The Hon. W. W. Niles, who was a member of the Commission which (in 1884) selected the 4000 acres of farm lands in the Annexed District, now included in the four great parks, declares most positively that in determining the total area of land to be condemned and purchased by the city the Commissioners made the area as large as it is in order to provide abundant room for the large zoological and botanical gardens which they felt sure would soon be established by the city. In other words, it was the deliberate *expectation and intention* of the Commissioners that both of the institutions now complained of should find homes on some of the lands then acquired. The Commissioners very wisely did not attempt to assign sites for the zoological and botanical gardens. In choosing a home for the former, the Zoological Society naturally inferred that the site which would be the most accessible to the public, and also immeasurably the best for the animals, was the proper one to choose. There are 3,500 acres of public parks in the Annexed District, untouched by the two scientific gardens, or five and one-half square miles. Is not that enough? Of the 261 acres alloted to the Zoological Park, the collections will be located on the least attractive portion; fully one-half of the total area (*all* of the picturesque portion) has been set aside as pleasure grounds, only."

THE INTERNATIONAL LEPROSY CONFERENCE.

AT the conclusion of the recent International Leprosy Conference at Berlin the secretaries drew up a summary of the results in English, German and French, intended especially for the governments who had sent delegates. The conclusions are as follows:

1. As might be expected, a considerable portion of the proceedings has been in connection with the bacillus of leprosy, which the Confer-

ence accepts as the virus of the disease, and which has been now known to the scientific world for upwards of twenty-five years through the important discovery of Hansen and the able investigations of Neisser.

2. The conditions under which the bacillus grows and develops are still unknown, as well as the way of its invasion into the human system; but from the discussions at the Conference it seems probable that a unanimity of opinion will soon prevail with regard to the modes of its dissemination throughout the body.

3. Very interesting observations have been brought forward concerning the large quantities of bacilli which are eliminated from the bodies of lepers through the skin and the buccal and nasal mucous membranes. It is desired that these observations be confirmed where opportunities occur. This question is important to those who are entrusted with the care of the public health, as we have to acknowledge that leprosy is a contagious disease.

4. Every leper is a danger to his surroundings, the risk varying with the nature and extent of his relations therewith and with the existing sanitary conditions. Although in the poorer classes the leper is especially a source of danger to his family and fellow workers, it cannot be denied that cases frequently occur also in the higher social circles.

5. The theory of the heredity of leprosy has lost ground in comparison with the now generally accepted opinion of its contagiousness.

6. The treatment of leprosy up to the present time has only had palliative results. Serum-therapy, so far, cannot be said to have been successful.

7. In view of the virtual incurability of leprosy and the serious and detrimental effects which its existence in a community causes, and considering the good results which have followed the adoption of legal measures of isolation in Norway, the Leprosy Conference, as a logical issue of the theory that the disease is contagious, has adopted the following resolution, proposed by Dr. Hansen and amended by Professor Besnier: (*a*) In countries where leprosy forms *foci* or has a great extension, isolation furnishes the best means of preventing the spread of the disease. (*b*) The system of obligatory notification, observation and isolation as carried out in Norway is recommended to all nations with local self-government and a sufficient number of physicians. (*c*) It must be left to the administrative authorities, after consultation with the medical authorities, to take such special measures as are applicable to the special social conditions of the districts.

GENERAL.

MR. HENRY S. PRITCHETT, Ph.D. (Munich), professor of physics and astronomy in Washington University, St. Louis, has been appointed by the President, Superintendent of the Coast and Geodetic Survey in the place of Gen. W. W. Duffield, resigned. Professor Pritchett was from 1878 to 1880 Assistant Astronomer at the Naval Observatory, Washington. He has engaged in work for the Survey in China and Japan as well as in the United States. We regret to notice the statement that Professor Pritchett is a Republican in politics, but hope that this is a mere accident and does not mean that the head of the Survey is liable to be changed every four years. There is every reason to believe that the Survey will now be conducted with the greatest efficiency and will contribute largely to the solution of the important practical and scientific problems with which it is charged.

IT is announced that the conference of delegates from the United States, Russia and Japan in regard to the seal fisheries has resulted in an agreement recommending the material limitation or complete suspension of pelagic sealing. Professor D'Arcy Thompson is now in Washington and it is expected that Mr. Macoun, the Canadian Minister of Marine, will shortly arrive, and that the conference between the United States, Great Britain and Canada will soon be held.

PROFESSOR F. F. MARTENS, professor of international law in the University of St. Petersburg, has been chosen an arbitrator in the question of the Venezuela boundary.

DR. H. HICKS, President of the Geological Society, London, has been awarded the jubilee medal established in commemoration of the sixtieth anniversary of the Queen's reign.

DR. EDMUND DRECHSEL, professor of physio-

logical and pathological chemistry and of pharmacology in the University of Berne, died on September 22d at Naples, where he was working at the zoological station on the chemistry of invertebrates. Drechsel was born at Leipzig in 1843 and was assistant to Kolbe, then professor of chemistry, and to Ludwig, then professor of physiology in that University. He was made associate professor at Leipzig in 1878 and was called to Berne in 1880. Physiological chemistry has recently suffered most serious losses in the deaths of Hoppe-Seyler, Baumann, Heidenhain and Drechsel.

DR. ALEXANDER MILTON ROSS died at Montreal on October 27th. He had made extensive collections of the fauna and flora of Canada and was the author of 'Birds of Canada' (1872); 'Butterflies and Moths of Canada' (1873); 'Flora of Canada' (1873); 'Forest Trees of Canada' (1874); 'Ferns and Wild Flowers of Canada' (1877); and 'Mammals, Reptiles and Fresh-water Fishes of Canada' (1878).

SIR PETER LE PAGE RENOUF, the eminent Egyptologist, died in London about the middle of October at the age of seventy-four years. He was the keeper of the Egyptian and Assyrian antiquities of the British Museum from 1885 to 1891, and was the author of several important publications, including the Hibbert lectures on 'The Religion of Ancient Egypt' (1897), and an edition of the 'Papyrus of Ani.'

THE following deaths are also announced: Dr. Leopold Auerbach, assistant professor of physiology in the University of Berlin; Dr. Mietschke, the German naturalist and entomologist; Dr. Hjalmar Heiberz, professor of pathological anatomy in the University of Christiania, and Dr. R. Branchat, professor of hygiene in the Medical Faculty of Granada.

IT is said that the Norwegian government will not only allow Captain Sverdrup the use of the 'Fram,' but will give him $50,000 for an outfit. According to *Petermann's Mitteilungen* Captain Sverdrup had given up the intention of making investigations between Spitzbergen and Greenland, and it had been decided that he should proceed up Baffin Bay and Smith Sound to the part of the Arctic ocean north of Greenland, which is the region Lieutenant Peary had previously announced his intention to explore.

A CABLEGRAM from Christiania states that the government has instructed the Governor of the Province of Tromsöe, the most northern province of Norway, to charter a steamer at the expense of the state, to provision it for six months and to send out a relief expedition for Herr Andrée, the aëronaut, who ascended in his balloon, the 'Eagle,' on July 11th. The relief steamer will start in three days' time from Tromsöe, and will proceed to Spitzbergen.

THE Imperial Russian Geographical Society will send at once an expedition, under the direction of M. Dmitrieff, to Abyssinia for anthropological research.

THE Austrian steamship 'Pola,' Captain Paul von Pott, has again gone to the Red Sea for scientific explorations, and will this year cover the ground between Dschedda and Aden. Dr. Franz Steindachner, the eminent ichthyologist, has charge of the zoological work, and explorations will also be made in physical oceanography.

PROFESSOR CHARLES BURCKHALTER, of Chabot Observatory, Oakland, Cal, has left for Hong Kong, and will proceed to India with his instruments for the purpose of observing and photographing the approaching total solar eclipse of the sun.

PRINCE PETER ALEXEIEVITCH KRAPOTKIN, the eminent Russian man of science, President of the Imperial Geographic Society, lectured in Washington on October 22d, before the National Geographic Society, on Russia and Siberia, dwelling at length on the geography of Siberia, which he compared with that of North America.

PROFESSOR ELLIOTT has been nominated for the presidency of the London Mathematical Society.

THE Astronomical Society of France held on October 6th its first meeting for the season. The President, M. Cornu, opened the session with an account of the astrophysical work of Fizeau. MM. Callandreau and Moye presented papers on the trajectories of comets and meteors.

THE Agnew Memorial Pavilion of the Hospital

of the University of Pennsylvania was opened on October 15th. It has been erected at a cost of $150,000, and in addition to 120 beds, dispensary rooms, etc., contains three ampitheaters, one with a seating capacity of 270.

MR. WILLIAM C. TODD, of Atkinson, N. H., has given the Boston Public Library $50,000, the income of which is to be used for the purchasing of newspapers.

THERE has been held at Sydney, New South Wales, during the present summer, an electrical exhibition at which engineering machinery and scientific apparatus were well represented. A large number of exhibits were sent from America and Great Britain.

THE Zoological Park, Washington, has received three young buffaloes purchased from the Allard herd in Montana.

THE Kingsley Laboratory, the new scientific building of the Worcester Academy, was dedicated on October 30th. Addresses were made by President Eliot, of Harvard University; President Hall, of Clark University, and President Mendenhall, of the Worcester Polytechnic Institute. The building is said to be the best equipped for the study of the sciences possessed by any secondary school.

AT a meeting of the Council of the Australasian Association for the Advancement of Science on September 8th the honorary Secretary, Professor A. Liversidge, stated that he had received the titles of the following addresses: Section C—Geology and Mineralogy: Professor Hutton, F.R.S., of New Zealand, upon 'Early Life on the Earth.' Section F—Anthropology and Ethnology: A. W. Howitt, of Melbourne, 'On the Origin of the Aborigines of Tasmania and Australia.' Section I—Sanitary Science and Hygiene: The Hon. Allan Campbell, of Adelaide, 'Australian Sanitation, a Jubilee Retrospect.' Among other papers announced in addition to those we have already noticed are the following bearing upon the natural history of Australasia: For Section C—Geology and Mineralogy: 'Notes on the Physiography of the Parish of St. George, New South Wales,' by E. J. Statham; 'On Some Effects of the Dynamo-Metamorphism in the Omeo District, Victoria,' by A. W. Howitt; 'Metallurgical Methods in Use at Broken Hill,' by G. W. Blakemore; two papers by Mr. J. C. H. Mingaye, on 'Occurrence of Phosphatic Minerals at the Jenolan Caves, with Analyses,' and 'Notes and Analyses of some New Wales Phosphate Minerals.' For Section D—Biology: 'On the Physiology of the Brain of Marsupials,' by Dr. J. F. Cashman; 'Notes on the Fertilization of some North Australian Plants,' by Nicholas Holtze; 'A Few Words about the Flora of the Islands of Torres Straits and the Mainland about Somerset,' and 'Notes on Plants of the Rabbit-infested Country, Bulloo River, Southwest Queensland,' with Photographic Illustrations,' by J. F. Bailey. For Section E—Geography: 'The Earliest Discoveries in New Guinea and Polynesia,' by James MacClymont; 'Gramineæ of Western Australia,' 'Salsolaceæ of Western Australia,' and 'The Supposed Poisonous Plants of Western Australia, by F. Turner.

TWO new museums will be opened at St. Petersburg in connection with the Army Medical Academy, one for psychiatry and one for neurology. The former will include objects illustrating the arrangements of asylums and the pathology of insanity, while the latter will illustrate the anatomy of the nervous system.

A PUBLICATION issued from the French Ministry of Finance gives some very elaborate statistics as to the quantity of wine, beer, cider, and alcohol consumed in the country. From the summary in the London *Times* we learn that the total quantity is 1,575,000,000 gallons, representing about 1½ litres per diem for the whole population of France. Out of the total quantity consumed 967,000,000 gallons are wine, 395,000,000 gallons cider, 202,500,000 gallons beer, and 36,800,000 gallons alcohol. It is scarcely necessary to say that, while the greater quantity of the wine is consumed in the large towns, the cider is nearly all drunk in the country, especially in Normandy and Brittany, and the official statistics give a table showing what is the consumption of wine in the 47 towns with over 30,000 inhabitants. The figures, as might be expected, vary very much, the annual consumption being largest at Boulogne-sur-Seine (59 gallons), Nice (56 gallons) and St. Etienne (54 gallons), while Paris is only 13th

on the list with 45 gallons. In none of the large towns in the South of France does the consumption fall below 30 gallons, but in seven large town in the North (Lille, Boulogne-sur-Mer, Dunkirk, Caen, Calais, Roubaix and Turcoing) it averages only six gallons. Another table gives the consumption of alcohol, and here Rouen, Cherbourg and Le Havre head the list with an annual total of nearly four gallons per head of the population, or more than double the quantity consumed in Paris.

UNIVERSITY AND EDUCATIONAL NEWS.

THE late George M. Pullman has left $1,200,000 for the erection and endowment of a manual training school in the town of Pullman.

THE Ohio Wesleyan University has received a bequest of $35,000 from the late Stephen Watson for the endowment of a professorship.

THE West Virginia University has followed the example of the University of Chicago, and will hereafter hold continuous session, the academic session being divided into four quarters of twelve weeks each with an intervening vacation of one week.

AN increase of forty-two students over last year is reported at Harvard College. The registration is as follows: Seniors, 337; juniors, 383; sophomores, 443; freshmen, 470; specials, 163; total, 1,796.

DR. CHARLES W. DABNEY, recently Assistant Secretary of Agriculture, and special agent in charge of scientific and statistical investigations, Washington, D. C., has been elected President of the University of Tennessee.

DR. ARTHUR ALLIN, of Ohio University, has been appointed professor of psychology and pedagogy in the University of Colorado.

DR. A. W. SHEEN has been appointed demonstrator in anatomy and Mr. S. C. Mahalanobis demonstrator of physiology in the medical department of University College of South Wales, Monmouthshire.

J. GRAHAM KERR, B.A., scholar of Christ's College, Cambridge, has been appointed demonstrator in animal morphology for a period of five years from October 1, 1897, in place of Mr. E. W. MacBride, who had resigned in order to accept the professorship of zoology in McGill University.

THE electors to the professorship of pathology, Cambridge University, will meet for the purpose of proceeding to the election of a professor on Saturday, November 6th. It is expected that Dr. Kanthack will be elected.

DR. HERMANN MUNK has been promoted to a full professorship of physiology at the University of Berlin. Dr. Hettner, of Leipzig, has been appointed assistant professor of geography in the University at Tübingen, and Dr. Max Busch assistant professor of analytical chemistry and chemical technology in the University at Erlangen.

THE annual report of President Schurman, of Cornell University, is the first of these important university publications to reach us. It opens with the minute adopted by the Board of Trustees on the death of their chairman, Mr. Henry W. Sage, who had made gifts to the University aggregating $1,175,000, and had given his services in many ways. The report reviews changes in the faculty, including some account of the work of Professors Dennis (analytical chemistry), Jacoby (civil engineering), Barr (mechanical engineering), and Trevor (chemistry), who were promoted to full professorships during the year. There were in the University 1,808 students, the number being practically the same as in 1893–4, before the requirements for admission were advanced. As Cornell is sometimes said to be developing into a great technological school rather than into a university it is interesting to note that in this period there has been a decrease of about 100 students in the departments of applied science and an increase of about 100 students in the academic departments. These numbered 593 students and there were 161 graduate students. President Schurman reviews the condition and work of the different departments and colleges of the University, the library, the grounds and the financial situation. The library now contains nearly 200,000 bound volumes; 10,000 have been added during the year. The financial statement is very brief. Except money paid from the Fayerweather estate, the University has received no bequests.

and but three small gifts. President Schurman's report, extending to 57 pages, is followed by appendices filling 117 pages, which give reports from other executive officers, the courses and attendance, and the publications by the University officers.

DISCUSSION AND CORRESPONDENCE.

ORGANIC SELECTION.

TO THE EDITOR OF SCIENCE: It seems to me that Professor Poulton's conclusion of the very interesting discussion on 'Organic Selection,' published in SCIENCE, October 15th, involves a serious confusion of ideas. He advocates the theory that natural selection confers on organisms the power of reacting adaptively to external forces. It is easy to conceive the effect of natural selection on an organism, assuming that the power of adaptation pre-exists; but it is incomprehensible that any amount of advantageous crossing should give the power of adaptation itself to an organism that does not already have it. Professor Poulton's arguments against that power being a property of a living organism are, I think, inconclusive. He dwells on the remarkable fact that physical forces awake responses which have to do with organic relations; but what of it? This shows only how powerful the tendency is. It is clear that any substance, animate or inanimate, reacts according to its own nature. If you drop a lighted match on to a pile of shavings, or on gunpowder, or into water, or on to a dog, certain pretty definite phenomena will occur in each case; yet the stimulus is the same; the recipient only is different. In the three earlier cases the results will be physical; in the case of the dog we reach the sphere of sensation. If the experiment be performed on a man we involve the moral sphere also, as he will either swear or refrain from swearing.

THOMAS DWIGHT.
ANATOMICAL DEPARTMENT,
HARVARD MEDICAL SCHOOL,
October 20, 1897.

A GASOLINE LAUNCH FOR FIELD WORK.

TO THE EDITOR OF SCIENCE: Last winter several papers and magazines, including SCIENCE (Vol. V., No. 119), noted the fact that I was constructing a gasoline launch for facilitating the study of paleontology and stratigraphic geology at Cornell University. Feeling that the results of this undertaking have been satisfactory in every way, and may be of interest to other investigators and teachers, I take pleasure in furnishing the following notes: First, as to what has been accomplished during the summer with this launch; second, why a naptha or gasoline launch is preferable to one propelled by steam.

July and August were spent on a long voyage from Ithaca to lower Chesapeake Bay and return, going *via* Erie Canal, Hudson River, Raritan River and Canal, Delaware River, Delaware and Chesapeake Canal, Chesapeake Bay and its many inflowing rivers. The special object of this expedition was to collect large quantities of Eocene and Miocene mollusca from Maryland and Virginia. Four students and myself constituted the party. During September a shorter excursion was made along the Erie Canal to Troy, N. Y., where Archæan, Cambrian, Ordovician, Silurian and Devonian outcrops were visited, either as they were found along the canal or at no great distance to the north or south. During term time the launch is being used for taking classes to fossiliferous outcrops along Cayuga Lake.

Now, a word as to why gasoline is preferable to steam:

1. Cost.—(*a*) Any well constructed boat 30 feet long, with a 6-horse power gasoline engine will run 800 miles on two barrels of oil; cost about $9.00 on an average, *i. e.*, a little over a cent a mile; (*b*) while on government waters no licensed engineer or pilot is required. With a few days' practice, under the direction of one acquainted with the engine, one learns his engine thoroughly and can as easily go up the Potomac to Washington as navigate his own mill-pond.

2. Freedom from government inspection.

3. There being no boiler or fire, the boat is light, roomy and cool.

4. When stopping at an outcrop no gasoline is being used. The whole machine is at a standstill, dead. But to start up and get under full speed requires less than a minute.

There are many other interesting points that ought to be touched on here, but space will

scarcely permit it. Those who may be interested in the subject are at liberty to make such inquiries of the writer as they see fit. Suffice it to say that in a country like our own, well traversed by water ways, a marine laboratory capable of rapid locomotion, at an exceedingly small cost, seems a very desirable adjunct to true university work in natural history subjects.

G. D. HARRIS.

CORNELL UNIVERSITY.

SCIENTIFIC LITERATURE.

Ueber Verwachsungsversuche mit Amphibienlarven. Von DR. G. BORN. Leipzig, W. Engelmann. 1897. (Reprinted from Archiv für Entwickelungsmechanik, Band IV.) 8vo. Pp. 224. Pls. I.–XI.

Professor Gustow Born is distinguished among living morphologists for the novelty and thoroughness of his investigations. It is to him that we owe the section modelling which is now so much used for the anatomical reconstruction of embryos, and which he has himself applied with brilliant results to the study of the development of the thyroid and of the heart. To him we owe also the experimental demonstration of the isotropism of the egg. In the present work we encounter again striking originality of method, coupled with extraordinary patience and thoroughness in the execution of the research. The method consists in the artificial union of two amphibian larvæ; this is accomplished by making a smooth cut on each larva, adpressing the two cut surfaces and allowing them to grow together; the natural fusion begins in half an hour to express itself and is complete in a few hours; in successful cases the united pair develop in unison and remain alive for weeks. Dr. Born's patience shows itself in the number and variety of fusions accomplished and in the exhaustive anatomical study of the developed monstrosities.

The only earlier experiments on fusion of two individuals were those of Trembley on Hydra, recently repeated by G. Wetzel. On the other hand, the announcement of Born's results has already occasioned a number of similar experiments on other animals. W. Roux appears to have first discovered the extraordinary power of the eggs and young larvæ of frogs of withstanding severe mechanical injury, and others have demonstrated the wonderful regenerative faculty of Amphibia during the early stages. Born has taken advantage of these characteristics to secure the concrescence of two individuals which develop afterwards as one. The spread of the ectoderms is the first step of the union, and there is in a short time a complete sheet of this tissue, with no visible break or trace of demarcation, extending from one larvæ to the other and covering the wound. This healing over is effected by the expansion of the sheet of ectoderms, and this expansion is not due to multiplication of the cells. Most of Born's experiments were made on larvæ of four millimeters (more or less) in length and on the following species: *Rana esculenta Bombinator igneus* and *Pelobates fuscus*; the larvæ of toads and of Rana fusca proved less favorable. Pieces of almost any size can be made to unite either of the same, or of different larvæ, and even of larvæ of two species. When the experiment succeeds such united pieces will live for about three weeks, or, in other words, until the supply of yolk material for the maintenance of growth is exhausted, but, if one or both the pieces have a digestive tract with mouth and arms, the united pieces may continue to develop indefinitely, and in such cases the blood channels of both species acquire open communication with one another, so that even when there is but one heart the blood circulates through both components. During the life of the fused larvæ, their development, their differentiation proceeds, each organ continues its progress. The development essentially follows the principles of Roux's mosaic theory.

The following schedule indicates the variety of successful unions accomplished by Professor Born:

A. Experiments on single larvæ.
  1. Pieces cut off and allowed to continue their development.
  2. Larva cut through and the pieces reunited.

B. Fusion of two larvæ, or parts of two larvæ.
  1. Both larvæ of the same species.
    a. Fusion of anterior with posterior pieces.
    b. Fusion by the ventral surfaces.
    c. Fusion of the posterior piece of one larva with the ventral side of another.

d. Fusion of the anterior piece of one larva with the ventral side of another.
e. Fusion of two posterior pieces.
f. Fusion of the heads of two larvæ.
g. Fusion of anterior pieces.

2. The larvæ belong to different species or even genera.
a. Fusion of the ventral surfaces.
b. Fusion of the posterior piece of one larva with the ventral surface of the other.
c. Fusion of an anterior with a posterior piece.
d. Fusion of the heads of two larvæ.

Every one of these unions was repeated many times, and the monograph presents an exact description of the anatomical condition of several specimens of each form of double larva, after the development had continued some weeks. These descriptions are based upon the examination of serial sections, the specimens being sacrificed on the microtomic altar. It is not using too strong a word to characterize the labor involved as enormous. The work, moreover, bears throughout the stamp of extreme conscientiousness.

It is impossible to enter here into details, but some of the general conclusions formulated by the author are so interesting that they are here presented. If, by the fusion, corresponding organs or their anlages are brought into contact they unite continuously by the concrescence of the specific tissue of the organ (the process might be appropriately named '*Histofusion*,' *Rev.*). If the anlages of unlike organs are brought in contact they become united by connective tissue. If the similar organs are hollow not only do their walls fuse, but also smooth open communication of their cavities is established, and in such cases it is not necessary that parts precisely corresponding should be joined. The different parts of the digestive tube will fuse, or the spinal cord will unite with the brain, and there will be produced a smooth passage from the cavity of one to that of the other, similarly in cases of fusion of the abdominal, pericardial or vascular cavities, of hearts, wolffian ducts, etc. Tissues are found united in this way which at the time of the union were still undifferentiated. Under certain conditions ectodermal and entodermal epithelia may become connected. The notochord takes an exceptional position in that the notochord of one piece does not concresce with that of another. The growing together of similar organs or tissues may occur in any plane or direction; there is no trace of polarity in the growth, such as Vöchting records for plants. The union of two pieces may be not only anatomical, but also physiological, and Born designates this as physiological symbiosis. It occurs in various degrees. In probably all cases the blood vessels are in open communication, so that the circulation is common to both components. A higher degree of symbiosis is marked in the cases where the intestine of the major larva has annexed a piece of the intestine of the minor, and both function together to the common advantage, or when the two larvæ have a stretch of intestine in common. The highest degree is reached when a whole end of the body, together with all its organs, is replaced, lengthened or doubled, for then the posterior piece from one larva works with the anterior piece of another, as if they were one individual. The highest degree is equally attained when the right and left halves of two larvæ are united in a single individual. The '*individuum*' is not dependent on the derivation from one egg. We have a single organism from two eggs (einen einheitlichen organismus aus zwei eiern). In the derivation from a single ovum there is no mystic, metaphysical unity.

The development, from the stage at which the experiments begin, depends upon self-differentiation of the single parts. No correlative influence of the surrounding parts can be recognized; the development is mosaic—Feis' organic areas (*organbildende Keimbezirke*) are partitioned off.

We commend this work to the attention of all biologists, and venture to predict that further important deductions will be garnered from these experiments of Professor Born, supplemented as they soon will be by additional researches. CHARLES S. MINOT.

The Concise Knowledge Library: Natural History. By R. LYDEKKER, W. F. KIRBY, B. B. WOODWARD, R. KIRKPATRICK, R. I. POCOCK,

R. BOWDLER SHARPE, W. GARSTANG, F. A. BATHER, H. M. BERNARD. New York, D. Appleton & Company. 1897. 8vo. Pp. 771. Price, $2.00.

The Concise Knowledge Library's *Natural History*—a misleading title inasmuch as the book contains no botany—treats of the animal kingdom from the higher mammalia down to the protozoa. Its authors, as may be seen from the above list, are Europeans, and the forms of life they describe and illustrate are, from the American standpoint, chiefly exotic. At the same time, where an abridged encyclopedia is wanted the book will be found convenient for reference.

The preface states that "the text is illustrated by upwards of five hundred original drawings made and reproduced expressly for the work." Those of the insects and some of the other invertebrates are fair; the remainder may probably be regarded as the worst batch of illustrations published in modern times. This is due partly to faulty drawing and partly to bad ink and poor printing. The type is small, and the volume as a whole has a cheap appearance, which ill fits the high reputation of its authors.

The mammals are treated first and come in for the largest share of attention (217 pages); then the birds, reptiles and fishes, and so on down the scale. Mammalogists will be amused to hear that the American black and grizzly bears "are now considered merely as varieties of the European species," and that "the stoat or ermine (*Mustela erminea*) and the weasel (*Mustela vulgaris*) are common to Europe, North and Central Asia, and North America." Perhaps the best feature of the book is its index, which occupies nearly fifty pages and is said to contain about ten thousand references.

C. H. M.

Citizen Bird: Scenes from Bird-Life in Plain English for Beginners. By MABEL OSGOOD WRIGHT and ELLIOTT COUES. With 111 illustrations by LOUIS AGASSIZ FUERTES. New York and London, The Macmillan Company. 8vo. Pp. 430. Price, $1.50.

Among the new books awaiting the reviewer on his recent return from the West is one which, from its authorship, attractive appearance and odd title, could not be put aside. 'Citizen Bird' is its name—a book for girls and boys. It is admirabiy written and is illustrated by a remarkable series of original drawings.

In order to test the book the reviewer called his children, two little girls, and read them the opening chapters. The younger (aged five years) was hardly able to follow the story, though interested in certain passages, but her elder sister (aged seven) was simply spellbound from first to last; from which it may be inferred that the book will hold the attention of children of seven and upwards.

The subject-matter is very cleverly woven into a story of a family of bird lovers in their country home at 'Orchard Farm.' The owner of the farm, who is a doctor and something of an ornithologist, takes the children out into the woods and fields and tells them about the birds, their habits and their value to man; and afterward, in his 'wonder room,' gives them special talks on particular species, which are grouped by some easily remembered characteristic, as 'a silver-tongued family' (bluebirds, robins and thrushes), 'Peepers and Creepers' (creepers, kinglets, chickadees and nuthatches) and so on. The children at once become enthusiastic observers and ask innumerable questions, which, in the main, are admirably answered. The story is charmingly told, kindling an interest in bird-life which is kept up to the end. The child is taught a multitude of entertaining facts about nature, and at the same time filled with a healthy sentiment against the wanton destruction of birds and their eggs.

A few of the statements are a little lax from the standpoint of scientific precision, and one or two of the incidents narrated are liable to tax one's credulity, as when one of the boys tells of brushing newly-fallen snow from the back of a live woodcock on its nest; but the book as a whole may be commended as by far the best bird book for boys and girls yet produced in America.

The illustrations deserve more than passing notice. They are uncommonly good half-tone reproductions of wash drawings by young Fuertes, whose phenomenal talent in grasping bird attitudes was first brought to the attention of the public in Miss Florence A. Merriam's

'*A' Birding on a Bronco*'. The present series of more than a hundred drawings, published for the first time in 'Citizen Bird,' fully sustains the artist's reputation. As would be expected in so large a series, a few are indifferent, but by far the greater number are remarkable for beauty, fidelity and power of expression. The pictures alone are worth the price of the book.

The typography and press work are of a high order of excellence, and the publishers are to be congratulated on the exceptional skill shown by their printer in handling difficult text figures. It is refreshing to find a book in the field of popular natural history which so distinctly raises the standard for its class and at the same time is offered for sale at so low a price.

C. H. M.

The Birds of Colorado. By W. W. COOKE. Fort Collins, Colorado, State Agricultural College, Agricultural Experiment Station. Bulletin No. 37. Technical Series No. 2. March, 1897. Pp. 1–143.

In view of the geographical situation of Colorado and its topographical features, a recent bulletin by Professor W. W. Cooke, of the State Agricultural College at Fort Collins, is of more than usual interest. It is a well annotated list of all the birds known to occur within the limits of the State. Other features—general discussion, historical résumé, classification of species as regards occurrence, and bibliography—contribute to its value. Considering the opportunity which the region offers, it is somewhat surprising that the author did not also attempt a definition and discussion of the life areas of the State.

The results have been derived largely from a summing up of previously published work, but in addition to this, much valuable new matter is included in the author's own notes and those which other observers placed at his disposal. The list is a large one, the number of species and subspecies attributed to the State being 363, of which 230 are breeders. To those previously recorded, 19 species are added. This makes an enviable total, but that it may still be increased is demonstrated by the outline of yet unworked territory. Colorado will always be an interesting ornithological field, and the present paper cannot fail to be of great service as a basis and stimulus for future work there.

W. H. OSGOOD.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON, 280TH MEETING, SATURDAY, OCTOBER 23.

MR. F. A. LUCAS described 'A Dangerous Parasite of the Fur-seal,' stating that it was a nematode of the genus *Uncinaria* found in the sandy portions of the seal rookeries of the Pribilof islands, and caused the death of many young seals. Dr. C. W. Stiles discussed the structure, habits and life history of allied forms.

Dr. C. W. Stiles spoke of 'The International Committee on Zoological Nomenclature,' and of what had been accomplished at the meeting of 1897.

Mr. M. B. Waite presented a communicatign on 'A New Peach and Plum Disease,' caused by a species of mite attacking and killing the terminal bud of the very young trees. The resulting loss in the value of the trees was considerable, as many thousand trees would be affected in one nursery. A similar disease prevailed in the Japanese quince.

Mr. F. V. Coville spoke of 'The History and Distribution of *Abies shastensis*,' which he had found in a recent trip through the Cascade mountains of Oregon to extend along the range north of the Oregon-California line as far as latitude 43° 35′. It has long been confounded with *Abies nobilis*, which is, however, a tree of more northern distribution.

F. A. LUCAS,
Secretary.

UNIVERSITY OF WISCONSIN SCIENCE CLUB.

AT the meeting of the Club on October 15, 1897, Mr. H. A. Harding, in a paper on 'Bacterial Plant Diseases,' spoke of the first discovery by Professor Burrill, of Illinois, and of the tardiness with which European investigators recognized this work. He showed the extent to which bacterial diseases occur, especially among our garden vegetables. Then followed a discussion of a disease occurring in the cauliflower and cabbage. The bacteria find entrance at the water-pores of the leaf and also through

insect wounds, and the disease causes a blackening of the fibro-vascular bundles, followed by the death of the plant.

Mr. Comstock presented an account of research work in progress at the Washburn Observatory. The meridian circle has been employed for some years by Mr. Flint in determining the relative parallaxes of a list of stars selected with reference to large proper motion. The observations for the determination of nearly 100 parallaxes are completed and the reductions are well advanced, although but a small number of definitive results have yet been reached. In so far as these have been obtained they are very satisfactory in respect both of probable error and agreement with other determinations.

There was also described work done with the 40 cm. equatorial telescope in investigations of stellar color and upon the density of the supposed lunar atmosphere. A provisional result of the latter work is that this density cannot exceed one five-thousandth part of that of the earth's atmosphere at sea level.

WM. S. MARSHALL,
Secretary.

SCIENTIFIC JOURNALS.

The American Journal of Science, November.—'Geology of Southern Patagonia,' J. B. Hatcher: An account of observations made while collecting vertebrate fossils for Princeton University from May 1, 1896, to June 5, 1897, giving suggestions as to the age and origin of the different sedimentary deposits and the agencies which have determined the present topographical features. 'Some of the large Oysters of Patagonia,' A. E. Ortmann. 'Former Extension of the Appalachians across Mississippi, Louisiana and Texas,' J. C. Branner: Evidence for the theory announced in 1890 regarding the character and extent of the southwestern Appalachian depression. 'Combustion of Organic Substances in the Wet Way,' I. K. Phelps: Extension of the process applied in a previous article to carbon dioxide. 'Some Features of Pre-Glacial Drainage in Michigan,' E. H. Mudge.

The American Naturalist, October.—'Edward Drinker Cope, Naturalist—A Chapter in the History of Science' (Illustrated), Theodore Gill: Address by the retiring President of the American Association for the Advancement of Science. 'New Observations on the Origin of the Galapagos Islands, with Remarks on the Geological Age of the Pacific Ocean,' G. Baur: Part II., giving the geographical distribution of different animals in the Pacific and Indo-Pacific Ocean. The number contains a portrait of the late James Ellis Humphrey, one of the associate editors of the journal.

Journal of Geology, September-October.—'The Newark System of New Jersey,' H. Kümmel: Based on the Annual Report of the State Geologist for 1896. 'The Topography of California,' Noah Fields Drake: Based on a relief map of California constructed by the author on a scale of 1 inch to 12 miles, and a vertical scale of 1 inch to 12,000 feet. 'A Comparative Study of the lower Cretaceous Formations and Faunas of the United States,' Timothy W. Stanton: A thesis submitted for Ph.D. degree in Columbian University, containing a bibliography filling 14 pages. 'Correlation of the Devonian Faunas in Southern Illinois,' Stuart Weller: Argues that the Devonian faunas in southern Illinois are not related to the Iowan Devonian faunas, but are a western extension of the faunas of the New York province.

NEW BOOKS.

The Ruins and Excavations of Ancient Rome. RODOLFO LANCIANE. Boston and New York, Houghton, Mifflin & Company. 1897. Pp. xxiv+619. $4.00.

Memorials of William Cranch Bond and of his Son George Phillips Bond. EDWARD S. HOLDEN. San Francisco, C. A. Murdock & Co.; New York, Lemcke & Buechner. 1897. Pp. iv+296.

Theory of Groups of Finite Order. W. BURNSIDE. Cambridge, The University Press. New York, The Macmillan Company. 1897. Pp. xvi+388. $3.75.

Song Birds and Water Fowls. H. E. PARKHURST. New York, Charles Scribner's Sons. 1897. Pp. viii+280. $1.50.

Erratum: In the report of the New York Section of the American Chemical Society, page 672, first column, line 33, for expensive read inexpensive.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; C. E. BESSEY, N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; C. S. MINOT, Embryology, Histology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, NOVEMBER 12, 1897.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*ASPECTS OF AMERICAN ASTRONOMY.**

THE University of Chicago yesterday accepted one of the most munificent gifts ever made for the promotion of any single science, and with appropriate ceremonies dedicated it to the increase of our knowledge of the heavenly bodies. The President of your University has done me the honor of inviting me to supplement what was said on that occasion by some remarks of a more general nature.

One is naturally disposed to say first what is uppermost in his mind. At the present moment this will naturally be the general impression made by what has been seen and heard. The ceremonies were attended not only by a remarkable delegation of cititizens, but by a number of visiting astronomers, which seems large when we consider that the profession itself is not at all numerous in any country. As one of these, your guests, I am sure that I give expression only to their unanimous sentiment in saying that we have been extremely gratified in many ways by all that we have seen and heard. The mere fact of so munificent a gift to science cannot but excite universal admiration. We knew well enough that it was nothing more than might have been expected from the public spirit of this great West; but the first view

*Address by Professor Simon Newcomb, LL.D., on the occasion of the dedication of the Yerkes Observatory, University of Chicago, October 22, 1897.

of a towering snow peak is none the less impressive because you have learned in your geography how many feet high it is, and great acts are none the less admirable because they correspond to what you have heard and read, and might therefore be led to expect.

The next gratifying feature is the great public interest excited by the occasion. That the opening of a purely scientific institution should have led so large an assemblage of citizens to devote an entire day, including a long journey by rail, to the celebration of yesterday is something most suggestive from its unfamiliarity. A great many scientific establishments have been inaugurated during the last half century, but if on any such occasion so large a body of citizens has gone so great a distance to take part in the inauguration the fact has at the moment escaped from my mind.

That the interest thus shown is not confined to the hundreds of attendants, but must be shared by your great public, is shown by the unfailing barometer of journalism. Here we have a field in which the non-survival of the unfit is the rule in its most ruthless form ; the journals that we see and read are merely the fortunate few of a countless number, dead and forgotten, that did not know what the public wanted to read about. The eagerness shown by the representatives of your press in recording everything your guests would say was accomplished by an enterprise in making known everything that occurred, and, in case of an emergency requiring a heroic measure, what did not occur, which shows that smart journalists of the East must have learned their trade, or at least breathed their inspirations in these regions. I think it was some twenty years since I told a European friend that the eighth wonder of the world was a Chicago daily newspaper. Since that time the course of journalistic enterprise has been in the reverse direction, to that of the course of empire eastward, instead of westward.

It has been sometimes said—wrongfully I think—that scientific men form a mutual admiration society. One feature of the occasion made me feel that we, your guests, ought then and there to have organized such a society, and forthwith proceeded to business ; this feature consisted in the conferences on almost every branch of astronomy by which the celebration of yesterday was preceded. The fact that beyond the acceptance of a graceful compliment I contributed nothing to these conferences relieves me from the charge of bias or self-assertion in saying that they gave me a new and most inspiring view of the energy now being expended in research by the younger generation of astronomers. All the experience of the past leads us to believe that this energy will reap the reward which Nature always bestows upon those who seek her acquaintance from unselfish motives. In one way it might appear that little was to be learned from a meeting like that of the present week ; each astronomer may know by publications pertaining to the science what all the others are doing. But knowledge obtained in this way has a sort of abstractness about it, a little like our knowledge of the progress of civilization in Japan, or of the great extent of the Australian continent. It was, therefore, a most happy thought on the part of your authorities to bring together the largest possible number of visiting astronomers from Europe as well as America, in order that each might see, through the attrition of personal contact, what progress the others were making in their researches. To the visitors, at least, I am sure that the result of this meeting has been extremely gratifying. They earnestly hope, one and all, that the callers of the conference will not themselves be more disappointed in its

results; that, however little they may have actually to learn of methods and results, they will feel stimulated to well-directed efforts and find themselves inspired by thoughts which, however familiar, will now be more easily worked out.

We may pass from the aspects of the case as seen by the more strictly professional class to those more general aspects fitted to excite the attention of the great public. From the point of view of the latter it may well appear that the most striking feature of the celebration is to be found in the great amount of effort which it shows to be devoted to the cultivation of a field quite outside the ordinary range of human interests. A little more than two centuries ago Huyghens prefaced an account of his discoveries on the planet Saturn with the remark that many, even among the learned, might think he had been devoting to things too distant to interest mankind an amount of study which would better have been devoted to subjects of more immediate concern. It must be admitted that this fear has not deterred succeeding astronomers from pursuing their studies. The enthusiastic students whom we see around us are only a detachment from an army of investigators who, in many parts of the world, are seeking to explore the mysteries of creation. Why so great an expenditure of energy? Certainly not to gain wealth, for astronomy is perhaps the one field of scientific work which, in our expressive modern phrase, 'has no money in it.' It is true that the great practical use of astronomical science to the country and the world in affording us the means of determining positions on land and at sea is frequently pointed out. It is said that an Astronomer Royal of England once calculated that every meridan observation of the moon made at Greenwich was worth a pound sterling, on account of the help it would afford to the navigation of the ocean. An accurate map of the United States cannot be constructed without astronomical observations at numerous points scattered over the whole country, aided by data which great observatories have been accumulating for more than a century and must continue to accumulate in the future.

But neither the measurement of the earth, the making of maps, nor the aid of the navigator is the main object which the astronomers of to-day have in view. If they do not quite share the sentiment of that eminent mathematician who is said to have thanked God that his science was one which could not be prostituted to any useful purpose, they still know well that to keep utilitarian objects in view would only prove a handicap on their efforts. Consequently, they never ask in what way their science is going to benefit mankind.

As the great captain of industry is moved by the love of wealth and the politician by the love of power, so the astronomer is moved by the love of knowledge for its own sake, and not for the sake of its application. Yet he is proud to know that his science has been worth more to mankind than it has cost. He does not value its results merely as a means of crossing the ocean or mapping the country, for he feels that man does not live by bread alone. If it is not more than bread to know the place we occupy in the universe it is certainly something which we should place not far behind the means of subsistence. That we now look upon a comet as something very interesting, of which the sight affords us a pleasure unmixed with fear of war, pestilence or other calamity, and of which we therefore wish the return, is a gain that we cannot measure by money. In all ages astronomy has been an index to the civilization of the people who cultivated it. It has been crude or exact, enlightened or mingled with superstition, according to the current mode of thought. When once men understand

the relation of the planet on which they dwell to the universe at large superstition is doomed to speedy extinction. This alone is an object worth more than money.

Astronomy may fairly claim to be that science which transcends all others in its demands upon the practical application of our reasoning powers. Look at the stars that stud the heavens on a clear evening. What more hopeless problem to one confined to earth than that of determining their varying distances, their motions and their physical constitution? Everything on earth we can handle and investigate. But how investigate that which is ever beyond our reach, on which we can never make an experiment? On certain occasions we see the moon pass in front of the sun and hide it from our eyes. To an observer a few miles away the sun was not entirely hidden, for the shadow of the moon in a total eclipse is rarely 100 miles wide. On another continent no eclipse at all may have been visible. Who shall take a map of the world and mark upon it the line on which the moon's shadow will travel during some eclipse a hundred years hence? Who shall map out the orbits of the heavenly bodies as they are going to appear in a hundred thousand years? How shall we ever know of what chemical elements the sun and the stars are made? All this has been done, but not by the intellect of any one man. The road to the stars has been opened only by the efforts of many generations of mathematicians and observers, each of whom began where his predecessor had left off.

We have reached a certain stage where we know much about the heavenly bodies. We have mapped out our solar system with great precision. But how with that great universe of millions of stars in which our solar system is only a speck of star dust, a speck which a traveler through the wilds of space might pass a hundred times without notice? We have learned much about this universe, though our knowledge of it is still dim. We see it as a traveler on a mountain top sees a distant city in a cloud of mist, by a few specks of glimmering light from steeples or roofs. We want to know more about it, its origin and its destiny; its limits in time and space, if it has any; what function it serves in the universal economy. The journey is long, yet we want, in knowledge at least, to reach the stars. Hence we build observatories and train observers and investigators. Slow, indeed, is progress in the solution of the greatest of problems when measured by what we want to know. Some questions may require centuries, others thousands of years for their answer. And yet never was progress more rapid than during our time. In some directions our astronomers of to-day are out of sight of those of fifty years ago; we are even gaining heights which twenty years ago looked hopeless. Never before had the astronomer so much work, good, hard, yet hopeful work, before him as to-day. He who is leaving the stage feels that he has only begun and must leave his successors with more to do than his predecessors left him.

To us an interesting feature of this progress is the part taken in it by our own country. The science of our day, it is true, is of no country. Yet, we very appropriately speak of American science from the fact that our traditional reputation has not been that of a people deeply interested in the higher branches of intellectual work. Men yet living can remember when in the eyes of the universal church of learning all cisatlantic countries, our own included, were *partes infidelium.*

Yet American astronomy is not entirely of our generation. In the middle of the last century Professor Winthrop of Harvard was an industrious observer of eclipses and kindred phenomena, whose work was recorded in the transactions of learned socie-

ties. But the greatest astronomical activity during our colonial period was that called out by the transit of Venus in 1769, which was visible in this country. A committee of the American Philosophical Society at Philadelphia organized an excellent system of observations, which we now know to have been fully as successful, perhaps more so, than the majority of those made on other continents, owing mainly to the advantages of air and climate. Among the observers was the celebrated Rittenhouse, to whom is due the distinction of having been the first American astronomer whose work has an important place in the history of the science. In addition to the observations which he has left us, he was the first inventor or proposer of the collimating telescope, an instrument which has become almost a necessity wherever accurate observations are made. The fact that the subsequent invention by Bessel was quite independent does not detract from the merits of either.

Shortly after the transit of Venus which I have mentioned, the War of the Revolution commenced. The generation which carried on that war, and the following one which formed our Constitution and laid the bases of our political institutions, were naturally too much occupied with these great problems to pay much attention to pure science. When the great mathematical astronomers of Europe were laying the foundation of celestial mechanics their meetings were a sealed book to every one on this side the Atlantic, and so remained till Bowditch appeared, early in the present century. His translation of the *Mécanique Céleste* made an epoch in American science by bringing the great work of Laplace down to the reach of the best American students of his time.

American astronomers must always honor the names of Rittenhouse and Bowditch. And yet, in one respect their work was disappointing of results. Neither of them was the founder of a school. Rittenhouse left no successor to carry on his work. The help which Bowditch afforded his generation was invaluable to isolated students who, here and there, dived alone and unaided into the mysteries of the celestial motions. His work was not mainly in the field of observational astronomy, and therefore did not materially influence that branch of the science. In 1832 Professor Airy, afterward Astronomer Royal of England, made a report to the British Association on the condition of practical astronomy in various countries. In this report he remarked that he was unable to say anything about American astronomy because, so far as he knew, no public observatory existed in the United States.

William C. Bond, afterward famous as the first Director of the Harvard Observatory, was at that time making observations with a small telescope, first near Boston, and afterward at Cambridge. But with so meager an outfit his establishment could scarcely lay claim to being an astronomical observatory, and it was not surprising if Airy did not know anything of his modest efforts.

If at this time Professor Airy had extended his investigations into yet another field, with a view of determining the prospects for a great city at the cite of Fort Dearborn, on the southern shore of Lake Michigan, he would have seen as little prospect of civic growth in that region as of a great development of astronomy in the United States at large. A plat of the proposed town of Chicago had been prepared two years before, when the place contained perhaps half a dozen families. In the same month in which Professor Airy made his report, August, 1832, the people of that place, then numbering twenty-eight voters, decided to become incorporated, and selected five trustees to carry on their government.

In 1837 a city charter was obtained from

the Legislature of Illinois. The growth of this infant city, then small even for an infant, into the great commercial metropolis of the West has been the just pride of its people and the wonder of the world. I mention it now because of a remarkable coincidence. With this civic growth has quietly gone on another, little noted by the great world, and yet in its way equally wonderful and equally gratifying to the pride of those who measure greatness by intellectual progress. If it be true that "in nature nothing is great but man, in man nothing is great but mind," then may knowledge of the universe be regarded as the true measure of progress. I, therefore, invite attention to the fact that American astronomy began with your city, and has slowly but surely kept pace with it until to-day our country stands second only to Germany in the number of researches being prosecuted, and second to none in the number of men who have gained the highest recognition by their labors.

In 1836 Professor Albert Hopkins, of Williams College, and Professor Elias Loomis, of Western Reserve College, Ohio, both commenced little observatories. Professor Loomis went to Europe for all his instruments, but Hopkins was able even then to get some of his in this country. Shortly afterward a little wooden structure was erected by Captain Gilliss on Capitol Hill, at Washington, and supplied with a transit instrument for observing moon culminations in conjunction with Captain Wilkes, who was then setting out on his exploring expedition to the southern hemisphere. The date of these observatories was practically the same as that on which a charter for the City of Chicago was obtained from the Legislature. With their establishment the population of your city had increased to 703.

The next decade, 1840 to 1850, was that in which our practical astronomy seriously commenced. The little observatory of Captain Gilliss was replaced by the Naval Observatory, erected at Washington during the years 1843–4 and fitted out with what were then the most approved instruments. About the same time the appearance of the great comet of 1843 led the citizens of Boston to erect the observatory of Harvard College. Thus it is little more than half a century since the two principal observatories in the United States were established. But we must not for a moment suppose that the mere erection of an observatory can mark an epoch in scientific history. What must have made the decade of which I speak ever memorable in American astronomy was not merely the erection of buildings, but the character of the work done by astronomers away from them as well as in them.

The Naval Observatory very soon became famous by two remarkable steps which raised our country to an important position among those applying modern science to practical uses. One of these consisted of the researches of Sears Cook Walker on the motion of the newly-discovered planet Neptune. He was the first astronomer to determine fairly good elements of the orbit of that planet, and, what is yet more remarkable, he was able to trace back the movement of the planet in the heavens for half a century and to show that it had been observed as a fixed star by Lalande in 1795 without the observer having any suspicion of the true character of the object.

The other work to which I refer was the application to astronomy and to the determination of longitudes of the chronographic method of registering transits of stars or other phenomena requiring an exact record of the instant of their occurrence. It is to be regretted that the history of this application has not been fully written. In some points there seems to be as much obscurity as with the discovery of ether as an an-

æsthetic, which took place about the same time. Happily, no such contest has been fought over the astronomical as over the surgical discovery, the fact being that all who are engaged in the application of the new method were more anxious to perfect it than they were to get credit for themselves. We know that Saxton, of the Coast Survey; Michell and Locke, of Cincinnati; Bend at Cambridge, as well as Walker and other astronomers at the Naval Observatory, all worked at the apparatus; that Maury seconded their efforts with untiring zeal, that it was used to determine the longitude of Baltimore as early as 1844 by Captain Wilkes, and that it was put into practical use in recording observations at the Naval Observatory as early as 1846.

At the Cambridge Observatory the two Bonds, father and son, speedily began to show the stuff of which the astronomer is made. A well devised system of observations was put in operation. The discovery of the dark ring of Saturn and of a new satellite to that planet gave additional fame to the establishment.

Nor was activity confined to the observational side of the science. The same decade of which I speak was marked by the beginning of Professor Pierce's mathematical work, especially his determination of the perturbations of Uranus and Neptune. At this time commenced the work of Dr. B. A. Gould, who soon became the leading figure in American astronomy. Immediately on graduating at Harvard, in 1845, he determined to devote all the energies of his life to the prosecution of his favorite science. He studied in Europe for three years, took the doctor's degree at Göttingen, came home, founded the *Astronomical Journal*, and took an active part in that branch of the work of the Coast Survey which included the determination of longitudes by astronomical methods.

An episode which may not belong to the history of astronomy must be acknowledged to have had a powerful influence in exciting public interest in that science. Professor O. M. Mitchel, the founder and first Director of the Cincinnati Observatory, made the masses of our intelligent people acquainted with the leading facts of astronomy by courses of lectures which, in lucidity and eloquence, have never been excelled. The immediate object of the lectures was to raise funds for establishing his observatory and fitting it out with a fine telescope. The popular interest thus excited in the science had an important effect in leading the public to support astronomical research. If public support, based on public interest, is what has made the present fabric of American astronomy possible, then should we honor the name of a man whose enthusiasm leavened the masses of his countrymen with interest in our science.

The Civil War naturally exerted a depressing influence upon our scientific activity. The cultivator of knowledge is no less patriotic than his fellow citizens, and vies with them in devotion to the public welfare. The active interest which such cultivators took, first in the prosecution of the war and then in the restoration of the Union, naturally distracted their attention from their favorite pursuits. But no sooner was political stability reached than a wave of intellectual activity set in, which has gone on increasing up to the present time. If it be true that never before in our history has so much attention been given to education as now; that never before did so many men devote themselves to the diffusion of knowledge, it is no less true that never was astronomical work so energetically pursued among us as now. One deplorable result of the Civil War was that Gould's *Astronomical Journal* had to be suspended. Shortly after the restoration of peace, instead of re-establishing the journal, its founder conceived the project of exploring

the southern heavens. The northern hemisphere being the seat of civilization, that portion of the sky which could not be seen from our latitudes was comparatively neglected. What had been done in the southern hemisphere was mostly the occasional work of individuals and of one or two permanent observatories. The latter were so few in number and so meager in their outfit that a splendid field was open to the inquirer. Gould found the patron which he desired in the government of the Argentine Republic, on whose territory he erected what must rank in the future as one of the memorable astronomical establishments of the world. His work affords a most striking example of the principle that the astronomer is more important than his instruments. Not only were the means at the command of the Argentine observatory slender in the extreme when compared with those of the favored institutions of the north, but, from the very nature of the case, the Argentine Republic could not supply trained astronomers. The difficulties thus growing out of the administration cannot be overestimated. And yet the sixteen great volumes in which the work of the institution has been published will rank in the future among the classics of astronomy.

Another wonderful focus of activity, in which one hardly knows whether he ought most to admire the exhaustless energy or the admirable ingenuity which he finds displayed, is the Harvard Observatory. Its work has been aided by gifts which have no parallel in the liberality that prompted them. Yet without energy and skill such gifts would have been useless. The activity of the establishment includes both hemispheres. Time would fail to tell how it has not only mapped out important regions of the heavens from the north to the south pole, but analyzed the rays of light which come from hundreds of thousands of stars by recording their spectra in permanence on photographic plates. The work of the establishment is so organized that a new star cannot appear in any part of the heavens, nor a known star undergo any noteworthy change, without immediate detection by the photographic eye of one or more little telescopes, all seeing and never sleeping policemen, that scan the heavens unceasingly while the astronomer may sleep, and report in the morning every case of irregularity in the proceedings of the heavenly bodies.

Yet another example showing what great results may be obtained with limited means is afforded by the Lick Observatory, of California. During the ten years of its activity its astronomers have made it known the world over by its unequaled works and discoveries, too varied and numerous to be even mentioned at the moment.

The astronomical work of which I have thus far spoken has been almost entirely that done at observatories. I fear that I may in this way have strengthened an erroneous impression that the seat of important astronomical work is necessarily connected with an observatory. It must be admitted that an institution which has a local habitation and a magnificent building commands public attention so strongly that valuable work done elsewhere may be overlooked. A very important part of astronomical work is done away from telescopes and meridian circles, and requires nothing but a good library for its prosecution. One who is devoted to this side of the subject may often feel that the public does not appreciate his work at its true relative value, from the very fact that he has no great buildings or fine instruments to show. I may, therefore, be allowed to claim as an important factor in the American astronomy of the last half century an institution of which few have heard and which has been overlooked because there was nothing about it to excite attention.

In 1849 the *American Nautical Almanac* office was established by a Congressional appropriation. The title of this publication is somewhat misleading in suggesting a simple enlargement of the family almanac which the sailor is to hang up in his cabin for daily use. The fact is that what started more than a century ago as a nautical almanac has since grown into an astronomical ephemeris for the publication of everything pertaining to times, seasons, eclipses and the motions of the heavenly bodies. It is the work in which astronomical observations made in all the great observatories of the world are ultimately utilized for scientific and public purposes. Each of the leading nations of western Europe issues such a publication. When the preparation and publication of the *American Ephemeris* was decided upon the office was first established in Cambridge, the seat of Harvard University, because there could most readily be secured the technical knowledge of mathematics and theoretical astronomy necessary for the work.

A field of activity was thus opened, of which a number of able young men who have since earned distinction in various walks of life availed themselves. The head of the office, Commander Davis, adopted a policy well fitted to promote their development. He translated the classic work of Gauss, *Theovia Motus Corporum Cœlestium*, and made the office a sort of informal school, not, indeed, of the modern type, but rather more like the classic grove of Hellas, where philosophers conducted their discussions and profited by mutual attrition. When, after a few years of experience, methods were well established and a routine adopted, the office was removed to Washington, where it has since remained. The work of preparing the ephemeris has, with experience, been reduced to a matter of routine which may be continued indefinitely with occasional changes in methods and data and improvements to meet the increasing wants of investigators.

The mere preparation of the ephemeris includes but a small part of the work of mathematical calculation and investigation required in astronomy. One of the great wants of the science to-day is the re-reduction of the observations made during the first half of the present century, and even during the last half of the preceding one. The labor which could profitably be devoted to this work would be more than that required in any one astronomical observatory. It is unfortunate for this work that a great building is not required for its prosecution, because its needfulness is thus very generally overlooked by that portion of the public interested in the progress of science. An organization especially devoted to it is one of the scientific needs of our time.

In such an epoch-making age as the present it is dangerous to cite any one step as making a new epoch. Yet it may be that when the historian of the future reviews the science of our day he will find the most remarkable feature of the astronomy of the last twenty years of our century to be the discovery that this steadfast earth of which the poets have told us is not after all quite steadfast; that the north and south poles move about a very little, describing curves so complicated that they have not yet been fully marked out. The periodic variations of latitude thus brought about were first suspected about 1880, and announced with some modest assurance by Küstner, of Berlin, a few years later. The progress of astronomical opinion from incredulity to confidence, was extremely slow until, about 1890, Chandler, of the United States, by an exhaustive discussion of innumerable results of observations, showed that the latitude of every point on the earth was subject to a double oscillation, one having the period of a year, the other of 427 days

Notwithstanding the remarkable parallel between the growth of American astronomy and that of your city, one cannot but fear that if a foreign observer had been asked only half a dozen years ago at what point in the United States a great school of theoretical and practical astronomy, aided by an establishment for the exploration of the heavens, was likely to be established by the munificence of private citizens, he would have been wiser than most foreigners had he guessed Chicago. Had this place been suggested to him I fear he would have replied that were it possible to utilize celestial knowledge in acquiring earthly wealth here would be the most promising seat for such a school. But he would need to have been a little wiser than his generation to reflect that wealth is at the base of all progress in knowledge and the liberal arts; that it is only when men are relieved from the necessity of devoting all their energies to the immediate wants of life that they can lead intellectual lives, and that we should therefore look to the most enterprising commercial center as the likeliest seat for a great scientific institution.

Now we have the school, and we have the observatory, which we hope will in the near future do work that will cast luster on the name of its founder as well as on the astronomers who may be associated with it. You will, I am sure, pardon me if I make some suggestions on the subject of the future needs of the establishment. We want this newly founded institution to be a great success, to do work which shall show that the intellectual productiveness of your community will not be allowed to lag behind its material growth. The public is very apt to feel that when some munificent patron of science has mounted a great telescope under a suitable dome and supplied all the apparatus which the astronomer wants to use success is assured. But such is not the case. The most important requisite, one more difficult to command than telescopes or observatories, may still be wanting. A great telescope is of no use without a man at the end of it, and what the telescope may do depends more upon this appendage than upon the instrument itself. The place which telescopes and observatories have taken in astronomical history are by no means proportional to their dimensions. Many a great instrument has been a mere toy in the hands of its owner. Many a small one has become famous. Twenty years ago there was here in your own city a modest little instrument which, judged by its size, could not hold up its head with the great ones even of that day. It was the private property of a young man holding no scientific position and scarcely known to the public. And yet that little telescope is to-day among the famous ones of the world, having made memorable advances in the astronomy of double stars and shown its owner to be a worthy successor of the Herschels and the Struves in that line of work.

A hundred observers might have used the appliances of the Lick Observatory for a whole generation without finding the fifth satellite of Jupiter; without successfully photographing the cloud forms of the Milky Way; without discovering the extraordinary patches of nebulous light, nearly or quite invisible to the human eye, which fill some regions of the heavens.

When I was in Zurich last year I paid a visit to the little but not unknown observatory of its famous polytechnic school. The professor of astronomy was especially interested in the observations of the sun with the aid of the spectroscope, and among the ingenious devices which he described, not the least interesting was the method of photographing the sun by special rays of the spectrum which had been worked out at the Kenwood Observatory in Chicago. The Kenwood Observatory is not, I believe, in the eye of the public one of the

noteworthy institutions of your city which every visitor is taken to see, and yet this invention has given it an important place in the science of our day.

Should you ask me what are the most hopeful features in the great establishment which you are now dedicating, I would say that they are not alone to be found in the size of your unequaled telescope, nor in the cost of the outfit, but in the fact that your authorities have shown their appreciation of the requirements of success by adding to the material outfit of the establishment the three men whose works I have described.

Gentlemen of the Trustees, allow me to commend to your fostering care the men at the end of the telescope. The constitution of the astronomer shows curious and interesting features. If he is destined to advance the science by works of real genius he must, like the poet, be born, not made. The born astronomer, when placed in command of a telescope, goes about using it as naturally and effectively as the babe avails itself of its mother's breast. He sees intuitively what less-gifted men have to learn by long study and tedious experiment. He is moved to celestial knowledge by a passion which dominates his nature. He can no more avoid doing astronomical work, whether in the line of observations or research, than the poet can chain his Pegasus to earth. I do not mean by this that education and training will be of no use to him. They will certainly accelerate his early progress. If he is to become great on the mathematical side, not only must his genius have a bent in that direction, but he must have the means of pursuing his studies. And yet I have seen so many failures of men who had the best instruction, and so many successes of men who scarcely learned anything of their teachers, that I sometimes ask whether the great American celestial mechanician of the twentieth century will be a graduate of a university or of the backwoods.

Is the man thus moved to the exploration of nature by an unconquerable passion more to be envied or pitied? In no other pursuit does success come with such certainty to him who deserves it. No life is so enjoyable as that whose energies are devoted to following out the inborn impulses of one's nature. The investigator of truth is little subject to the disappointments which await the ambitious man in other fields of activity. It is pleasant to be one of a brotherhood extending over the world in which no rivalry exists except that which comes out of trying to do better work than anyone else, while mutual admiration stifles jealousy. And yet, with all these advantages, the experience of the astronomer may have its dark side. As he sees his field widening faster than he can advance he is impressed with the littleness of all that can be done in one short life. He feels the same want of successors to pursue his work that the founder of a dynasty may feel for heirs to occupy his throne. He has no desire to figure in history as a Napoleon of science whose conquests must terminate with his life. Even during his active career his work may be of such a kind as to require the cooperation of others and the active support of the public. If he is disappointed in commanding these requirements, if he finds neither cooperation nor support, if some great scheme to which he may have devoted much of his life thus proves to be only a castle in the air, he may feel that nature has dealt hardly with him in not endowing him with passions like to those of other men.

In treating a theme of perennial interest one naturally tries to fancy what the future may have in store. If the traveler contemplating the ruins of some ancient city which in the long ago teemed with the life and activities of generations of men sees

every stone instinct with emotion and the dust alive with memories of the past, may he not be similarly impressed when he feels that he is looking around upon a seat of future empire, a region where generations yet unborn may take a leading part in moulding the history of the world? What may we not expect of that energy which in sixty years has transformed a straggling village into one of the world's great centers of commerce? May it not exercise a powerful influence on the destiny not only of the country, but of the world? If so, shall the power thus to be exercised prove an agent of beneficence, diffusing light and life among nations, or shall it be the opposite? The time must come ere long when wealth shall outgrow the field in which it can be profitably employed. In what direction shall its possessors then look? Shall they train a posterity which will so use its power as to make the world better that it has lived in it? Will the future heir to great wealth prefer the intellectual life to the life of pleasure?

We can have no more hopeful answer to these questions than the establishment of this great university in the very focus of the commercial activity of the West. Its connection with the institution we have been dedicating suggests some thoughts on science as a factor in that scheme of education best adapted to make the power of a wealthy community a benefit to the race at large. When we see what a factor science has been in our present civilization, how it has transformed the world and increased the means of human enjoyment by enabling men to apply the powers of nature to their own uses, it is not wonderful that it should claim the place in education hitherto held by classical studies. In the contest which has thus arisen I take no part but that of a peacemaker, holding that it is as important to us to keep in touch with the traditions of our race and to cherish the thoughts which have come down to us through the centuries as it is to enjoy and utilize what the present has to offer us. Speaking from this point of view, I would point out the error of making the utilitarian applications of knowledge the main object in its pursuit. It is a historic fact that abstract science, science pursued without any utilitarian end, has been at the basis of our progress in the application of knowledge. If in the last century such men as Galvani and Volta had been moved by any other motive than love of penetrating the secrets of nature they would never have pursued the seemingly useless experiments they did, and the foundations of electrical science would not have been laid. Our present applications of electricity did not become possible until Ohm's mathematical laws of the electric current, which when first made known seemed little more than mathematical curiosities, had become the common property of inventors. Professional pride on the part of our own Henry led him, after making the discoveries which rendered the telegraph possible, to go no further in their application of his discoveries, and to live and die without receiving a dollar of the millions which the country has won through his agency.

In the spirit of scientific progress thus shown we have patriotism in its highest form—a sentiment which does not seek to benefit the country at the expense of the world, but to benefit the world by means of one's country. Science has its competition, as keen as that which is the life of commerce. But its rivalries are over the question who shall contribute the most and the best to the sum-total of knowledge—who shall give the most, not who shall take the most. Its animating spirit is love of truth. Its pride is to do the greatest good to the greatest number. It embraces not only the whole human race, but all nature in its scope. The public spirit of which this city is the focus has made the desert blossom as

the rose, and benefited humanity by the diffusion of the material products of the earth. Should you ask me how it is in the future to use its influence for the benefit of humanity at large, I would say, look at the work now going on in these precincts, and study its spirit. Here are the agencies which will make 'the voice of law the harmony of the world.' Here is the love of country blended with the love of the race. Here the love of knowledge is as unconfined as your commercial enterprise. Let not your youth come hither merely to learn the forms of vertebrates and the properties of oxides, but rather to imbibe that Catholic spirit which, animating their ever-growing energies, shall make their power an agent of beneficence to all mankind.

S. NEWCOMB.

WASHINGTON, D. C.

THE YERKES OBSERVATORY.

THE opening of the Yerkes Observatory has been an important event in the progress of science. The last masterpiece of Alvan G. Clark, the forty-inch refractor, has been appropriately established. A great institution for all branches of research in the related fields of astronomy and astrophysics has begun its activity. The University of Chicago has made an important addition to its already large equipment for the discovery and teaching of scientific truth.

A series of conferences, attended by a representative gathering of some sixty of the astronomers and astrophysicists of the country, occupied the three days preceding the formal exercises of dedication on October 21st and 22d. The program, as printed in the recent number of this JOURNAL (No. 147, October 22d) was carried out with but minor changes.

Stimulating discussions followed the presentation of many of the papers, in which a delightful feature was the participation of Professor Carl Runge, of Hannover. Unfortunately, a necessary postponement of the date of the exercises had made it impossible for Professor Schuster, of Manchester, Eng., and M. Deslandres, of Paris, to remain for the conferences.

The demonstrations, in the various laboratories of the Observatory, of new and interesting phenomena formed an important part of the program. The weather was not sufficiently favorable to permit the exhibition, with the great telescope, of many of the celestial objects as planned, but all present on the first two days had the opportunity of testing the light-grasp of the instrument on double stars and nebulæ, and in connection with the solar spectroscope.

The generous hospitality of the University provided for its scientific guests during the week unique entertainment in the spacious rooms of the Observatory itself, and the arrangements for this rather serious undertaking were admirably carried out, with the effective cooperation of a well-known Chicago caterer. To the full extent of their capacity the homes of the resident astronomers were also thrown open to their friends.

The location of the Observatory, selected after long deliberation and full examination of the available situations, commends itself at once, aside from its natural beauty, by reason of its isolation from traffic and manufacturing, a favorable condition which is likely to continue into an indefinite future. The center of motion of the great refractor is about 80 meters above the level of Lake Geneva, which is about 600 meters distant, the elevation above sea-level being about 400 meters. The railway station and post office are over a kilometer distant, at Williams Bay, Wisconsin, on the Chicago and Northwestern Railway, at a distance of 120 kilometers, or two and one-half hours, from Chicago.

The Observatory building, of brown Ro-

man brick, with terra cotta trimmings, is in the form of a Latin cross, having a longer axis of one hundred meters, with the great tower and dome at its western end, and with two smaller (ten-meter) domes at the northern and southern extremities of the shorter axis. A meridian room, with double sheet-iron walls, is at the eastern end of the building. The space of thirty-two meters in the attic between the small towers serves as a heliostat room. The main floor of the building contains offices, computing rooms, spectroscopic laboratories, an instrument and a photographic room, a chemical laboratory, a lecture room, library and reception room. The lower story, or basement, contains a concave grating room, an emulsion, an enlarging and a photographic dark room, and a constant temperature room. Very important features of this floor are the optical and the instrument shops, well supplied with machines and tools. Here large instruments are being constructed, and a sixty-inch glass reflector is now being ground by the optician.

The great dome, twenty-seven meters in diameter and eighteen meters in height, is provided with a rising floor having a vertical range of seven meters and operated by electric motors. This floor is a very essential feature in working with a telescope of sixty-two feet focal length and successfully overcomes what would otherwise be almost insurmountable (acrobatic) difficulties in observing. The massive iron and steel mounting of the forty-inch telescope (constructed, as were the dome and rising floor, by Warner and Swazey), is operated by electric motors regulated at the eye-end. The driving clock controls the motion of a mass of twenty tons.

The tests of the optical efficiency of the telescope have been thoroughly satisfactory. It has also been already demonstrated that the 'seeing' by day is excellent at Williams Bay, a fortunate condition in view of the disturbed day atmosphere at the Lick Observatory, but it is not to be expected that the night seeing can equal that at Mt. Hamilton.

The northeastern dome, nine meters in diameter, shelters the telescope formerly at the Kenwood Observatory, having two 12-inch objectives, visual and photographic. The southeast tower will for the present be occupied by a reflecting telescope. The equipment of the Yerkes Observatory in solar and stellar spectroscopes, gratings and kindred apparatus is already large. The gifts of Mr. Yerkes have included: For the objective, $66,000; for the equatorial mounting, $55,000; for the dome and rising floor, $45,000; for the building and smaller domes, stellar spectrograph, steam heating plant and power house, engine, dynamo and motors, over $145,000. The fifty-five acres of land, valued at $50,000, was given by Mr. John Johnston, Jr.; the instruments of the Kenwood Observatory by Mr. W. E. Hale; and $7,000 for a 10-inch photographic telescope, with building and dome, by Miss Catherine Bruce, of New York, to whose liberality astronomy owes much.

The address at the formal exercises of dedication was delivered in the ninety-foot dome, before a company of six hundred of the officers and guests of the University, by Professor J. E. Keeler on 'The Importance of Astrophysical research and the relation of Astrophysics to other physical sciences.' In a few well chosen words Mr. Charles T. Yerkes presented the deed of the institution to the President of the Trustees of the University, who responded in their behalf, as did President Harper for the Faculty. After a luncheon and inspection of the Observatory a special train conveyed the visitors to Chicago.

On the following day, October 22d, striking demonstrations were given, at the Ryerson Physical Laboratory by Professors Michel-

son and Stratton, of the applications of the interference refractometer and of the effect of a magnet upon radiation recently discovered by Zeeman. Professor Michelson also exhibited a harmonic analyzer, which may, perhaps, find application to certain pending problems of astronomy. The visiting scientists were entertained at luncheon by the President of the University and Mrs. Harper, and at 3 p. m. an address on 'Aspects of American Astronomy' was delivered by Professor Simon Newcomb. Finally the liberal hospitality of Mr. Yerkes provided a banquet in the evening for the visiting scientists.

The work of the Yerkes Observatory has thus been formally inaugurated. The aims of the institution as expressed by the President cannot fail to meet the approval of all friends of science:

"It is proper that a word should be said on behalf of the Faculty with respect to the policy which shall control the University in the use it shall make of the Observatory. The founder has indicated his desire in definite form that the Observatory shall not be used for popular purposes. Situated as it is, in close proximity to a village of large size, and within a short distance of so great a city as Chicago, it would be comparatively easy for the astronomers to occupy their entire time in exhibiting the instruments to the public. For the present it is the desire of the donor and the decision of the Trustees that the Observatory shall not be open to the public.

"In every department of science there is opportunity to-day for the development of what might be called the sensational. In no subject is this possibility greater than in that of astronomy. The work of not a few observatories and of not a few astronomers has been seriously injured by the desire to do and say that which will attract public attention. The Yerkes Observatory will strenuously oppose every tendency of this character, and will make every effort to represent only that kind of work which is of solid and substantial character.

"So much for the negative side. As to the positive policy of the Observatory, I quote from a statement of the Director: 'The policy of the Yerkes Observatory will be: (1) To derive the greatest possible return from the use of the large telescope it is evident that special attention should be given to (*a*) micrometrical observations of stars, satellites, comets, nebulæ, etc.; (*b*) solar investigations, both visual and photographic; and (*c*) spectroscopic researches on the chemical composition of the stars and their motion toward or from the earth. The present staff is sufficient to permit much of this work to be taken up to advantage. Another astronomer will be needed to develop the spectroscopic work, which is, probably, the most important work the Observatory can undertake, on account of its great light-gathering power.

"'(2) To provide for the investigation of any phase of an astronomical or related physical problem. Most American observatories are unprovided with the instruments and laboratories necessary for the interpretation of the phenomena constantly encountered in spectroscopic observations of the heavenly bodies. Spectroscopic laboratories, on the other hand, are not equipped to carry their investigations beyond the artificial boundaries of physics into the realm of astronomy. It is hoped that the Yerkes Observatory may ultimately be in a position to represent both the astronomical and the physical sides of astrophysical work, and at the same time provide the best facilities for research work in astronomy of position.'"

The present staff of the Observatory consists of Professor George E. Hale, Director; Professors S. W. Burnham, E. E. Barnard, F. L. O. Wadsworth; Mr. F. Ellerman, Assistant; Mr. G. W. Ritchey, Optician.

It would appear an urgent need that adequate endowment should be supplied for the maintenance of this splendid institution at the high degree of efficiency of which it is so capable.

EDWIN B. FROST.

THE ALUMNI BIOLOGICAL EXPEDITION OF NEW YORK UNIVERSITY TO THE BERMUDAS.

THE archipelago of the Bermudas was chosen as the ground for the first expedition of the Biological Department of the University for several reasons, among them the following: the means of communication, by the steamships of the Quebec S. S. Co., was easy; they seemed to afford a tropical marine fauna in abundance for study; they were free from the malarious diseases of the West Indies, the fatality of which was so sadly proved this summer in the expedition to Jamaica, and it seemed worth while to investigate the conditions under which a station might be established for permanent research.

Thanks to a number of alumni who made liberal contributions to the enterprise, the party left New York for Hamilton on June 3d. The party consisted of Dr. C. L. Bristol, in charge; Mr. Warren H. Everett, instructor, and Messrs. Brush, Carpenter, Brown, Rosenthal and Grose, of the University; Dr. Walter M. Rankin, of Princeton University, and Dr. Tarleton H. Bean, late of the U. S. Fish Commission and now Director of the Aquarium in New York City. The party was joined later by Mr. Ernest Haycock, of Harvard University. The last of the party arrived in New York on August 8th. Headquarters were established at the Harrington House, about six miles from Hamilton and situated on the narrow strip of land separating Harrington Sound from Castle Harbor. A vacant house near the shore of Castle Harbor was transformed into a comfortable laboratory, and from this as a center trips were made in various directions.

The most attention was given to a search for the various forms and a careful survey of the general conditions subtending their abundance and collection, so that, taken as a whole, the work might prove a reconnaissance and furnish knowledge for future investigations. In this the expedition was fairly successful and would have been much more so but for a long spell of southwest wind which prevented off-shore work, excepting for a few days. One instance of this may be given. Captain Meyers, of St. Georges, very kindly put his large ocean-going tug and a diver at our disposal to go to North Rock, and for a whole week we waited before a favorable morning came, but on that day, just as we arrived at the collecting ground, a heavy wind prevented any serious work. Our work was confined mainly to the lee shores and here we were greatly rewarded. Of corals the genera *Diploria*, *Meandrina*, *Astrea*, *Siderastrea*, *Porites*, *Isophyllia*, *Oculina* and *Mycedium* were found; of gorgonians, *Rhipidogorgia* and *Gorgonia*. The Actinaria are very abundant and our collections are numerous. We found but few hydroids and a millespore coral. The Medusæ and Hydro-Medusæ are very abundant in the still waters of Harrington Sound. The Echinoderms are exceedingly interesting and abundant. The Holothuria are represented by the genera *Holothuria*, *Semperia*, *Stichopus*, the last being very abundant. The Asteroidea are few and are represented by one species of *Asterias* and one of a new genus not yet determined; the Ophiuroidea by several genera. The Echinoidea are represented by *Cidaris*, *Diadema*, *Hipponœ*, *Echinometra*, *Toxopneustes*, *Mellita* and one new genus. The Crustacea are numerous and exceedingly interesting. Our collections will be studied by Dr. Rankin, who will report on them later.

The Mollusca of the archipelago number, according to Heilprin, about 170 marine forms and 30 terrestrial. Among the cephalopoda are *Octopus* and *Argonauta*. The naked *Aplysia* is fairly abundant, and, numerous other naked mollusks are found in Harrington Sound.

The Annelids are not as numerous in the places we searched as we expected, but those we found are new to us and the genera are not yet determined. The sponges are very numerous in genera and plenty in individuals. The Tunicates are exceedingly numerous and offer a rich field for investigations. *Amphioxus* is reported, but we had no opportunity to search for it. The abundance and beauty of the Bermuda fishes is notorious. Dr. Bean is making a study of them, carrying on the work started by his colleague, the late G. Brown Goode. Incidental to the main work of the expedition we undertook to furnish the Aquarium in New York with live specimens of some of these fishes, and thousands of visitors to that institution testify to their beauty and gracefulness. This part of the work was by no means the least interesting. We installed four large tanks and a pumping engine on White's Island, in the harbor of Hamilton, and acclimated the fish before transferring them to the steamship. On board the boat the fish were supplied with running water, thanks to the kindness of the Quebec Steamship Company, and no small part of our success was due to the generous and skillful aid given us by the Chief Engineer, Mr. Ritchie. Under these favorable conditions our loss was slight and another season will be much less. It is interesting to note that our efforts to bring invertebrates alive failed in every case but one, though we could keep them in prime condition until we struck the polluted waters of the coast, when they died quickly. Our failures, however, have suggested remedies, and next year we hope to show *Octopus*, *Palinurus*, *Ibacus*, *Aplysia* and the sea-anemones, as well as the fishes. The fishes thrive in the Aquarium, although the water is several degrees cooler than they are accustomed to and the salinity much less. There would be little difficulty apparently in carrying them from New York across the Atlantic, if that were desirable, under the same conditions that we carried them from Bermuda.

Our hasty survey strengthens the idea of establishing a station, and we are planning to have one in working condition by the summer of 1899, if not before. It will have two stories, the lower given up to aquaria, as at Naples, and open to the public during the winter at a small fee; the upper story will be fitted up for a laboratory, and while under the charge of the University will be open to any one competent to carry on an investigation in botany or zoology. It is not intended to rival any of the stations on the Atlantic coast, but to supplement them and to afford opportunity to investigators of America and Europe to study the flora and fauna of a tropical horizon with ease and comfort. The healthfulness of the place is attested to by the yearly visitation of over two thousand guests who spend the winter months there. Malaria is unknown, as is also prostration by heat. The climate during June and July is not disagreeable, the thermometer rarely going up beyond 82° F.

Another project in hand with the station at the Bermudas is the exploration of the West Indies with the Bermudas as a base. Two lines of steamers connect the islands with the West Indies, and the scientist starting on them equipped from the appliances of the station may make a rapid collecting trip to a desired location and return to work over his material under the more favorable conditions at the station.

Charles L. Bristol.

New York University.

NEW DIAMOND FIND IN THE TRANSVAAL.

THE latest Johannesburg papers (*Standard and Diggers' News, Financial Record*) bring news of a very interesting and probably economically important discovery of diamonds in place, at a distance of no less than 300 miles from the mines of Kimberley and Jagersfontein. The locality is 20 miles east of Pretoria, the capital of the South African Republic, and one mile east of Merwe, a station on the railway leading to Delagoa Bay. The outcrop forms a knoll, or 'kopje,' in the Magaliesburg range. It is on the farm Rietfontein, No. 501. The first announcement of the discovery was made to the Johannesburg Geological Society by Dr. David Draper, on September 12th.

The diamonds are found in a matrix, called by Mr. G. A. F. Molengraaff, State Geologist of the Transvaal, serpentine breccia, similar in nature to kimberlite. This rock extends over a small area not yet fully explored, but known to be at least 160 feet by 250 feet, and believed to be a volcanic neck. The kimberlite is much less decomposed than at Kimberley, the yellow ground being only 5 feet in depth, and the blue ground projecting above the general level, while at Kimberley the yellow or oxidized zone extended to more than 100 feet below the surface.

Only ten 'loads' (of 16 cubic feet) of rock had been washed up to September 20th. These, however, had yielded 23 stones. Dr. Draper reports one stone of 16 carats, another of 23, and the rest smaller. The 16-carat stone is said in the *News*, of September 25th, to be a fragment broken from a larger stone, the remainder of which has not been found. The yield per load would seem to be very high, but the amount washed is too small to justify predictions, while it certainly indicates a good 'prospect.' Dr. Draper reports garnet, carbonado, olivine and 'other minerals associated with the diamond' as present in abundance. He very properly points out the likelihood that there are other diamond deposits in the neighborhood, and suggests the expediency of a search for them.

The new diamond deposit occurs in the quartzites of the Magaliesburg range, about 35 miles due north of the Main Reef Series of the Witwatersrand, at its farthest known eastern extension. The correlation of these quartzites and those along the Witwatersrand is not altogether certain. Some authorities have maintained that the Magaliesburg rocks are equivalent to the series underlying the Main Reef. Others, with better reason, as it seems to me, consider them equivalent to the Gatsrand Series which overlies the Black Reef, to the southward of the Witwatersrand. In either case they are Paleozoic, and much earlier than the coal measures of the Karoo, which are supposed to be Triassic, and which rest unconformably on the Black Reef Series. The rocks of these earlier formations contain no coal and no bituminous shales so far as is known. In this new diamond occurrence there is no apparent reason to attribute the formation of the crystals to the local effect of lava on superficial deposits of amorphous carbon. It will be interesting to ascertain whether the lava of the new locality contains a soluble hydrocarbon like that which Sir Henry Roscoe found in kimberlite.

Diamonds have not been found in the Transvaal in the original matrix until the discovery here reported. In 1893, however, diamonds are said to have been found in auriferous ore close to Klerksdorp, in the southern part of the Transvaal. The gold-bearing ore at this point is reputed to be pudding stone of the Cape formation. The diamonds, of which somewhere about a score were found, were small and of a greenish tint.* I am not aware that any

*C. S. Goldmann, South African Mining and Finance, Vol. 2, 1895–6, page 29.

further finds were made at this point. If there is no mistake about this occurrence, there must have been diamonds in this region long before the intrusion of any known mass of kimberlite.

In the Orange Free State there are a number of localities at which the diamond has been found, although Jagersfontein is the only one which has yielded this gem in important quantities. The most northerly locality in the Free State of which I have heard is at Driekopjes, in the Kroonstad district. This district is bounded on the north by the Vaal River and it lies just south of Potchefstroom district, in the Transvaal. It is to be hoped that some geologist may eventually visit all the known diamond-bearing localities in South Africa and give the world the benefit of a comparative study.

GEORGE F. BECKER.

WASHINGTON, October 31, 1897.

CURRENT NOTES ON PHYSIOGRAPHY.

THE GREAT LAKES.

GILBERT'S discussion of 'Modification of the Great Lakes by Earth Movement,' presented to the Detroit meeting of the American Association, is published in the September number of the *National Geographic Magazine* (VIII., 1897, 233–247). It is truly astonishing that in the dozen years since the tilting of the ancient lake shore lines was recognized, and in our brief half century of accurate lake levellings, quantitative results as definite as those here announced should have been reached. A change of level of 0.42 foot per 100 miles per century in a direction about S. 27° W. seems to be assured. A line at right angles to this direction, drawn through the outlet of a lake, would have no change of level. All places on the lake shore northeast of such a line, or isobase, would emerge from the lake waters; all places to the southwest would be slowly submerged. Ontario lies altogether southwest of the isobase of its outlet; and, hence, the water must be encroaching on all its shores; the estimated rise at Hamilton being six inches a century. Erie is similarly situated, and the rise at Toledo is placed at eight or nine inches per century. The outlet isobase of Huron-Michigan leaves Huron altogether on the northeast, and crosses Michigan near its middle; the water surface must, therefore, be lowered ten inches a century on the northeast side of Georgian Bay, and six inches at Mackinac; while it must rise five or six inches at Milwaukee, and nine or ten at Chicago. "Chicago has already lifted itself several feet to secure better drainage, and the time will surely come when other measures of protection are imperatively demanded." In 500 or 600 years, high stages of the lake will discharge at Chicago by the ancient outlet of glacial Lake Michigan. In 1,000 years the discharge will occur at ordinary lake stages, and after 1,500 years it will be continuous. In about 2,000 years the discharge from Lake Michigan-Huron-Erie * * * will be equally divided between the western outlet at Chicago and the eastern at Buffalo. In 2,500 years the Niagara River will have become an intermittent stream, and in 3,000 years all its water will have been diverted to the Chicago outlet, the Illinois River, the Mississippi River and the Gulf of Mexico."

THE LAVA PLATEAU OF SOUTHEASTERN WASHINGTON.

THE lava plateau of the Columbia River basin, already described by Russell (Bull. 108, U. S. G. S.) a few years ago, now receives further attention from the same author (Irrigation Papers, No. 4, U. S. G. S.). A broad flat dome, uplifted 2,000 feet over the surrounding country and well dissected, forms the Blue Mountains; so well clothed with rock waste that one is astonished to learn that they are composed of

horizontal strata of basalt. From these mountains northward towards Spokane River the surface is nearly level with a deep soil cover; but it is here and there cut by deep canyons, on whose sides the lava beds form dark cliff belts. The Snake River crosses the Blue Mountain uplift in a canyon 4,000 feet deep and fifteen miles broad. The Grande Ronde, rising in many branches in the same mountains, has excavated an intricate series of branching canyons. Here the spaces between the streams are no longer flat-topped remnants of the original plateau, but sharp-edged ridges, diversified with spires and pinnacles. This river has cut a meandering trench in the floor of a flat canyon three miles wide, indicating two partial cycles of erosion. Many special features suggest interesting physiographic problems: the gravel terraces of Snake River, that once enclosed lakes in tributary streams; the falls of the Palouse, apparently the result of recent diversion of the river to a new and shorter course to Snake River; the wandering behavior of the Walla Walla on an aggraded floor, calling for special legislation regarding its use in irrigating canals; the deep fine soil on the lava plains, here and there heaped in hills, like dunes, and everywhere producing great crops of wheat in an apparently desert region. Nothing is more remarkable than the remnants of the prelava topography, whether seen in such eminences as Steptoe butte, rising over the lavas and never buried, or revealed in Snake River canyon, where a magnificent 'shut in'* occurs as the river cuts its superposed course through a deep-buried mountain of schist. Several excellent illustrations accompany the report.

*See Science, III., 1896, 661.

HANDBOOK OF CANADA.

A Handbook of Canada, published for the British Association meeting at Toronto last summer by the Local Committee, contains an account of the physical features of the Dominion by G. M. Dawson, conveniently condensed for ready reference. Thus the interior plateau of the Cordilleran region, occupying an area of 100 by 500 miles between the Gold range on the east and the Canadian Coast range on the west, is described as a peneplain of Tertiary denudation, greatly modified by Miocene volcanic accumulations and by the excavation of valleys after elevation. Its true character as a table-land cannot be appreciated until rising high enough for the eye to range along its even sky lines. Unlike the forested mountains east and west, this plateau has a drier climate, and includes wide stretches of grass-covered hills and valleys, forming excellent cattle ranges. It appears to be be correlated with the basin areas of Cordilleran region within the United States.

W. B. Dawson describes the Canadian survey of tides and currents; stating, among other things, that the current in Belle Isle strait is tidal, with a flow nearly equal in each direction. The accepted theory of a constant inward cold current is thus proved to be unfounded and misleading.

W. M. Davis.

Harvard University.

CURRENT NOTES ON ANTHROPOLOGY.

THE ANCIENT MURMEX.

In Science, April 16th, and later in No. 1, of the *Bulletin* of the Museum of the University of Pennsylvania, I announced the identification of the classical object usually called a 'bow-puller' with the *Murmex*, fastened to the fist in pugilistic contests. This identification met with general acceptance, but a few authorities of great weight, such as Sir John Evans and Professor E. S. Morse, offered against it the cogent objection that if the implement was so used, it could scarcely fail to be repre-

sented on some of the existing remains of classical art, and that none such, so far as they knew, could be adduced.

I am glad to supply this deficiency in my argument, and thus place my identification beyond question. When in Paris, in September, I examined the galleries of ancient art in the museums of the Louvre with this in mind, and was fortunate in finding a striking and beautiful example in point. It is No. 68 in the 'Salle des Caryatides,' and is labelled 'Athlete Vainqueur au Pugilat.' Each hand is wrapped in a cestus, and each is armed with a three-pointed *Murmex,* as accurately represented in the marble as this material allows. The statue is late Greek, from Rome, and the originals of the arms are now in Rome. No more conclusive evidence of my argument could be desired.

THE GODS OF THE MAYAS.

SERIOUS students of the Mayan archæology will receive with great satisfaction the revised edition of the essay by Dr. Paul Schellhas on the figures of the gods in the Mayan manuscripts (Die Göttergestalten der Mayahandschriften, pp. 34, Dresden, Richard Bertling, 1897). It first appeared in the *Zeitschrift für Ethnologie,* 1892, but the author justly considers that the progress in this line of research called for a revision of the text. He pursues the same method as before, designating the divinities by letters, and discussing their proposed identifications as questions still open. All the important attempts in that direction are referred to, and such value assigned to them as he believes they merit. The mythological animals in the Codices are also named and figured, and their possible significations explained. The essay is dedicated to Dr. E. Förstemann, and certainly no one could be found more worthy of such a tribute.

A colored reproduction of page 11 of the Dresden Codex is given as the frontispiece, and a number of illustrations in the text render the descriptions clear to the reader.

ORIGIN AND IMPORT OF THE TOTEM.

THE institution of the Totem, or something equivalent to it, prevailed widely in savage conditions of life in both hemispheres. It has generally been considered to indicate kinship, either real or ceremonial. Miss Alice C. Fletcher, in her paper on 'The Import of the Totem,' read at the Detroit meeting, takes up the totemic bond as found among the Omahas, and argues that among them it was not primarily a tie of relationship, but a purely religious lien, which connected together individuals and groups who had received similar revelations from the gods. These joined in certain similar rites and formed societies devoted to special cults. In this manner the gentes and tribes came to be based on spiritual, not physical relationship. Although the origin was thus in one sense individual, it is recognized that a man of uncommon ability and fortune might impress the group who dwelt together with the power of his totem, that is, his vision, and this would naturally be sought after and found by his descendants. This would unite the physical and spiritual kinship.

The paper is quite original in thought and founded on close personal study of the savage mind, as is evident on every page.

D. G. BRINTON.
UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

Nature for September 23d contains an account of the series of micro-photographs of polished and etched surfaces of alloys, which were exhibited by Mr. J. E. Stead at the last conversazione of the Royal Society. These photographs show in many alloys, imbedded in the eutectic or what was once the mother liquor, crystals of alloys of definite

composition. Thus in copper-tin alloys rich in tin, crystals are found of the composition (approximate) Cu Sn, Cu_3 Sn_2 and Cu_2 Sn, according to the amount of copper present, the first mentioned separating from an alloy with 2% copper. In ternary alloys it has been found possible to detect two, and sometimes three, distinctly different compounds in the same microscopic field. The study of alloys by the microscope is a field which has hardly as yet been entered upon, but it promises very valuable results.

A new method for producing artificial diamonds is described by Dr. Q. Majorana in the *Rendiconti* of the Roman Academy. Carbon, heated in the electric arc is submitted to a pressure of 5,000 atmospheres generated by the action of an explosive compound on a small piston. The mass formed, which consists chiefly of graphite and amorphous carbon, is found to contain minute crystals, which show the properties of the diamond. It thus appears possible to transform amorphous carbon into the diamond directly without the medium of a solvent, which is used in Moissan's process.

The manufacture of mosaic gold (sublimed stannic sulfid) by the sublimation of tin-amalgam, sal ammoniac and sulfur was known to the later alchemists, but the part played by the sal ammoniac in the process has been a matter of conjecture, though the old process is in use to-day. It is often possible to obtain the mosaic gold by subliming the precipitated stannic sulfid with sulfur, but unless sal ammoniac is present this method often fails. In the *Zeitschrift für angewandte Chemie* J. Lagutt clears up the reaction by showing that the chlorin of the ammonium chlorid forms with the tin the volatile tetrachlorid, which is in turn decomposed by the sulfur, giving the sublimate of mosaic gold, while the ammonium chlorid is re-formed. Ammonium bromid can be substituted for the sal ammoniac, but no other ammonium salt. The formation of the mosaic gold from the direct sublimation of stannic sulfid and sulfur is accounted for by the presence of hydrochloric acid in the stannic sulfid. If this is thoroughly washed free from hydrochloric acid no mosaic gold is found.

From the new Davy-Faraday Research Laboratory comes a solution of another of the problems of the past. In 1841 Grove described a class of metallic nitrogen compounds to which he gave the name of 'nitrogurets.' These were formed by the action of six Grove cells on a concentrated solution of ammonium chlorid, with anode of zinc, cadimum, copper, etc., and kathode of platinum. Grove supposed the deposits to be compounds of ammonium analogous to ammonium amalgam, or of nitrogen and the metals. In the *Zeitschrift für Electrochemie* Heinrich Pauli describes a repetition of the experiments carried out in the Davy-Faraday Laboratory, and shows that with zinc anode Grove's zinc nitroguret is merely metallic zinc. With copper anode the deposit is a mixture of cuprous oxid and metallic copper, and with silver anode, silver oxid or silver according to the intensity of the current.

The proposal of Carnot to determine the geological age of a fossil by the relative quantity of fluorin and phosphate present has been applied, at the request of Dubois, the discoverer of the fossil remains of *Pithecanthropus erectus*, to determine whether this interesting specimen is really Pliocene. J. M. Van Bemmelen gives an account, in the *Zeitschrift für anorganische Chemie*, of an examination of the remains of a fossil elephant found in the same stratum with the *Pithecanthropus*. He finds the ratio of fluorin to phosphate in comparison with that of apatite to be 0.53, which is very close to 0.58, that given by Carnot as

characteristic of Pliocene fossils. This is a confirmation of the geological and paleontological evidence as to the age of the fossil.

SOME time since Dr. Matteucci announced the discovery of selenium in the fumarole products of Vesuvius. He now adds, in the *Rendiconti* of the Naples Academy, bromin and iodin, found for the first time in these products, though their existence was theoretically probable.

FROM an Associated Press dispatch of October 15th, we note the following, dated Berkeley, Cal.: "Gold from silver is not an impossibility, according to Edmund O'Neill, associate professor of chemistry at the University of California."

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE AMERICAN SOCIETY OF NATURALISTS.

THE American Society of Naturalists and the affiliated societies will meet at Ithaca, N. Y., on December 28th, 29th and 30th. All the societies will assemble in Sage College at 1 p. m., on Tuesday, December 28th, when an address of welcome will be made by President Schurman. The chief meeting of the Naturalists in which the other societies join is on Wednesday afternoon, for which the following program has been arranged:

I. Reports of Committees.
II. Election of new members.
III. Appointment of Special Committees.
IV. Discussion. The Biological Problems of To-Day.

Paleontology, Professor H. F. Osborn, Columbia University.

Botany, Professor Wm. Trelease, Missouri Botanic Gardens.

Anatomy, Professor Burt G. Wilder, Cornell University.

Psychology, Professor J. McKeen Cattell, Columbia University.

Physiology, Professor Jacques Loeb, University of Chicago.

Developmental Mechanics, Professor T. H. Morgan, Bryn Mawr College.

Morphogenesis, Professor Charles B. Davenport, Harvard University.

(The time allowed each speaker will be limited to ten minutes.)

Special Papers.

In the evening there will be the business session of the Naturalists and the annual dinner of the societies, at which the President, Professor C. O. Whitman, will make an address. The Ithaca Hotel will be the headquarters, but there are many excellent boarding houses at the campus, and the University will provide a luncheon each day. The members of the local committee are: Chairman, Professor S. H. Gage; Secretary, Professor W. W. Rowlee; Professor G. C. Caldwell, Professor B. G. Wilder, Professor I. P. Roberts, Professor S. G. Williams, Professor R. S. Tarr, Professor P. A. Fish, Professor E. L. Nichols, Professor L. A. Wait, Professor E. B. Titchener, Professor G. F. Atkinson, Professor L. H. Bailey.

The officers of the Naturalists are: President, C. O. Whitman; Vice-Presidents, H. P. Bowditch, E. B. Wilson, W. P. Wilson; Secretary, H. C. Bumpus; Treasurer, John B. Smith; other members of the Executive Committee, elected from the Society-at-large, Leslie A. Lee, George H. Parker.

The other societies meeting with the Naturalists are: The Association of American Anatomists, The Association for Botanical Morphology and Physiology, The American Morphological Society, The American Physiolgical Society, The American Psychological Association, Section H. (Anthropology) of the American Association for the Advancement of Science. The New York State Science Teachers' Association will meet at Ithaca, December 30th and 31st.

GENERAL.

THE National Academy of Sciences will hold its winter meeting next week in Boston, beginning on Tuesday, November 16th.

A COPE memorial meeting will be held in the Hall of the American Philosophical Society, Philadelphia, this evening, under the auspices of institutions with which Professsor Cope was connected. Addresses on the services to science by Edward Drinker Cope will be delivered as follows: Dr. Theodore Gill, Work in Fishes, Batrachia and Reptiles; Professor Henry F.

Osborn, Work in the Mammals; Professor William B. Scott, Contributions to Geology. The following delegates have been appointed to represent the cooperating associations on this occasion: A. S. Packard, National Academy of Sciences; William H. Dall, United States Geological Survey; Theodore Gill, American Association for the Advancement of Science; Henry F. Osborn, American Museum of Natural History; E. G. Conklin, University of Pennsylvania; Harrison Allen, Academy of Natural Sciences; William B. Scott, Wagner Free Institute of Science; William Pepper, American Philosophical Society.

REV. DR. SEARLE has resigned from the directorship of the astronomical observatory of the Catholic University of America, and Mr. Alfred Doolittle has been appointed to succeed him.

DR. W. v. BEZOLD, of Berlin, was awarded, on the occasion of its jubilee celebration, the gold medal of the Prussian Meteorological Institute.

THE Royal College of Physicians, London, has conferred the Baly Medal, given every three years for research in physiology, on Professor Schäffer, of University College, London.

QUEEN VICTORIA has conferred the Jubilee Medal upon Sir George Duffey, President of the Royal College of Physicians in Ireland, and upon Sir William Thomson, President of the Royal College of Surgeons in Ireland.

THROUGH *Nature* we learn that the Reale Accademia dei Lincei has recently elected the following associates and correspondents: National associate, in the section of zoology and morphology, Professor G. B. Grassi; correspondent, in the same section, Professor G. Fano; foreign associates in mathematics, Professors H. Weber and T. Reye; in mechanics, Professor G. H. Darwin; in mathematical and physical geography, Professor F. R. Helmert; in geology and paleontology, Professor A. Gaudry; in physiology, Professors H. Kronecker and O. Schmiedeberg.

DR. FOREL, professor of psychiatry in the University of Zurich and Director of the State Asylum for the Insane, has resigned these offices, owing, it is said, to the attacks made upon him by the press for the part he has taken in combatting the use of alcohol.

SIR RUTHERFORD ALCOCK died in London on November 2d, aged eighty-eight years. He had been President of the Royal Geographical Society and had published works on geography and hygiene.

A MEETING of the general committee having in charge the arrangements for the next International Congress of Zoology was held on November 4th. It will be remembered that the Congress meets in Cambridge on August 23d under the presidency of Sir William Flower.

THE Royal Academy of Belgium offers a series of prizes for 1898, the subjects of which are published in the *Revue Scientifique*. Four questions are proposed in mathematics and the physical sciences and three in the natural sciences, for the best answers to which small prizes (600–800 francs) are offered. The essays must be presented by the first of August, 1898, and we understand that foreigners may compete, though the MSS. must be in French or Dutch. A prize of 1,000 francs for the best work in astronomy by a Belgian is also offered. Further details regarding these prizes may be obtained from the Secretary of the Academy, Palais des Académies, Brussels.

SIR JOSEPH NORMAN LOCKYER, accompanied by Dr. W. J. S. Lockyer and Mr. A. Fowler, of the Royal Astronomical Society, will leave London on December 10th for Colombo to observe the total solar eclipse of January 21, 1898.

THE success attending the recent expedition of Mr. J. B. Hatcher, of Princeton University, as reported in a recent number of SCIENCE, has led him to return to that country to continue his investigations in paleontology and geology. Mr. Hatcher will land at Punta Arenas, in the Strait of Magellan, and will proceed northward to Chubut. In addition to paleontological collections, Mr. Hatcher expects to secure collections of natural history and ethnology.

MR. F. W. W. HOWELL proposes to attempt the ascent of Mt. Everest next year, and is said to have the cooperation of the Royal Geographical Society and the government of India.

PROFESSOR LAWRENCE BRUNER, of the Uni-

versity of Nebraska, whose departure for Argentine to study the plague of locusts we at the time noted, has safely arrived and is engaged in studying methods of mitigating the plague.

THE Philadelphia museums have in working order their 'Laboratory of Tests and Technology,' to be operated in connection with the other work now being done by the Commercial Museum. The laboratory is maintained as an adjunct of the scientific department, of which Gustave Niederlien, now absent in Central America, is the chief. The work of the laboratories, however, is under the immediate direction of Dr. Louis J. Matos.

THE firm of Siemens & Halske, electrical engineers, celebrated last month the fiftieth anniversary of the foundation of the firm. The firm established a fund of 1,000,000 Marks for the benefit of its workmen and officers, and appointed a committee to consider the best use to be made of the money. Herr Wilhelm Siemens delivered a speech, dwelling upon the two guiding principles of the firm, namely, scientific research and perfection of work.

THE British government has declined to take part in the Florida Fisheries Conference, stating that, while greatly interested in the objects of the Conference, it is unable to send an official representative.

THE opening meeting and exhibition of the Röntgen Society was held in St. Martin's Town Hall on November 5th. Professor Sylvanus P. Thompson gave a presidential address.

WE learn from *Garden and Forest* that a State Forestry Society was organized at Raleigh, North Carolina, on October 21st, with fifteen members. The Society elected Mr. W. E. Petty, Carthage, President; Dr. C. A. Schenck, Biltmore, Vice-President; Professor W. W. Ashe, of the North Carolina Geological Survey, Secretary and Treasurer. The main object of the Society is to lessen forest fires in North Carolina, which are doing great injury to pine lands, especially in the southeastern part of the State, in the valley of the lower Cape Fear River. Methods of improving the condition of lumbered and deteriorated woodland will also be considered, and the re-establishment of waste and eroded agricultural lands in timber.

AT the Wagner Free Institute of Science, Philadelphia, ten weeks' courses are now being given in the evenings as follows: Mondays, Professor S. T. Wagner, 'Engineering Materials;' Tuesdays, Professor W. B. Scott, 'Historical Geology;' Wednesdays, Professor R. E. Thompson, 'History;' Thursdays, Professor G. F. Stradling, 'Magnetism;' Fridays, Professor Henry Leffmann, 'Chemistry;' Saturdays, Professor Emily G. Hunt, 'Chapters from the Life of Plants.' These courses are now in session.

AT a recent meeting of the Board of Directors of the American Chemical Society it was decided to appoint a committee of three, with Dr. Wiley as chairman, with power to take charge of a want column in the *Journal* of the Society. Members of the Society seeking positions, and, also, persons desiring to employ chemists, will be allowed a three and one-half inch advertisement free of charge.

A NEW building for the chemical laboratory of the University of Berlin is now in course of erection, at a cost of about $250,000. It will contain four large laboratories, with desks for 250 students and 25 research rooms.

A PASTEUR Institute was opened in Sofia on October 18th.

PROFESSOR WILTSHIRE has presented to the mineralogical museum of Cambridge University his collection of minerals, which includes numerous specimens of high scientific value. The zoological museum has also been enriched by the addition of a collection of polyzoa presented by Miss E. C. Jelly, and of the skeleton of an elephant seal, the gift of Sir W. L. Buller.

THE New York *Evening Post* reports that Prince Roland Bonaparte has been paying the expenses of meteorological experiments made in the upper strata of the atmosphere with a balloon presented to the Central Meteorological Bureau by M. Balaschoff.

ESSAYS in competition for the Alvarenga prize of the College of Physicians of Philadelphia must be sent to the Secretary of the College by May 1, 1898. The value of the prize is about $180 and the essay may be upon any medical subject.

THE publication of the *Academische Revue*, which has contained full news and valuable

discussions of university education in Germany, will, we regret to learn, be suspended, owing to lack of financial support. The *Hochschul-Nachrichten* will, however, be continued at a cost of 6 Marks per annum.

IN the address on behalf of the faculties of the University of Chicago at the dedication of the Yerkes Observatory, described elsewhere in the present issue, President Harper gave details regarding the cost of the equipment. There was first of all the forty-inch objective, the greatest and last work of its maker, Alvan G. Clark. This objective cost, when finished, $66,000; the equatorial mounting, and the dome and rising floor cost $55,000 and $45,000 respectively. To these there must be added, as distinct gifts, the 30-foot dome for the southeast tower which cost $7,000, the 26-foot dome and mounting of the Kenwood telescope; likewise the stellar spectrograph, constructed by Mr. J. A. Brashear, costing $3,000. Besides all these, the building with its piers for the instruments, its steam-heating plant, engines, dynamos and motors, the cost of which has been in round numbers $135,000. Acknowledgment was also made of three additional gifts which had already come to the Observatory: The grounds on which it has been built, consisting of 55 acres valued at $50,000, a contribution of Mr. John Johnston, Jr.; the instruments and equipment of the Kenwood Observatory, presented to the Yerkes Observatory by Mr. William E. Hale, and the gift of Miss Catharine Bruce, of New York City, of $7,000, for a ten-inch photographic telescope with building and dome.

MR. H. C. COOPER writes us from Heidelberg calling attention to a curious exhibition of paternalism on the part of the University. All students doing laboratory work, and even attending experimental lectures in chemistry or physics, are *required* to take out an accident insurance policy covering accidents occurring in the exercises. Students entirely disabled are to receive $500 per annum, with a corresponding allowance for lesser injuries. The risk is probably not as great as outsiders may suppose from this regulation, as the premium for lecture courses per semester is only two and a-half cents.

PROFESSOR J. A. UDDEN, of Augustana College, Rock Island, Ill., writes us that Dr. N. O. Holst, of the Geological Survey of Sweden, has lately had two years' leave of absence from his work on the Survey for the purpose of studying the new gold fields in western Australia. After leaving this southern continent he visited New Zealand, China, and Japan, and then returned by way of Canada and the United States. He has seen the ancient Australian glacial deposit which is supposed to belong to the Permian age, and he says there can be no doubt but that it is an indurated boulder-clay. Its age may possibly be somewhat later than heretofore supposed, but not so much later as to detract from the importance of its bearing on the subject of geological climate. In the semi-desert, where Dr. Holst spent most of his time, the wind did not appear to him to be of any great importance as a geological agent, although dust storms are sometimes reported from the new towns on the border of the desert. One of the Australian geologists has lately made some interesting observations on what resembles a tidal action of the ground water in the sandy region in the interior. The water rises and falls at regular daily intervals, and the oscillations appear to be too great to be explained as resulting from the daily variations in atmospheric pressure.

A CORRESPONDENT writes to the London *Times* that the site of the prehistoric Celtic lake village near Glastonbury has been further excavated since July last, under the superintendence of the discoverer, Mr. Arthur Bulleid. The sites of the dwelling are marked by mounds. One of these contained the greatest depth of clay yet found, no less than 9 feet; the accumulation of successive hearths which were found necessary as the weight of the clay gradually compressed the peat beneath. This mound contained 300 tons of clay, all of which must have been brought in their boats by the inhabitants from the neighboring hills. Under the mound was found the framework of a loom with brushwood and wattlework to form the foundation. That the inhabitants were much engaged in spinning is clear from the fact that, in addition to other things connected with the craft, no fewer than forty horn and bone carding combs

have been unearthed. The number of broken bone needles and splinters of bone found in one mound seem to indicate that it was utilized as a needle factory. Another mound was very rich in fragments of pottery and other evidences of the manufacture of hardware. As usual, very few human remains were discovered, part of the skeleton of a very young child being all that was brought to light this summer. With the exception of the cracked skulls of a few unfortunate warriors, the remains of very young children have chiefly been found in past years, Mr. Bulleid being of the opinion that these primitive people conveyed their dead to the neighboring hills for interment. Parts of three broken millstones were unearthed, and in one mound a clay oven, measuring 2 feet by 9 inches. One glass article only was brought to light this year, a blue glass bead with a wavy line of dark blue running round it. Altogether the season's work has proved very interesting, and the British Association is so well satisfied with the discoveries made from time to time that at their Toronto meeting they renewed their grant towards the excavation fund.

A MUSEUM of Natural History and Anthropology was opened at Wernigerode on July 29th. It was planned by the late Prince Otto von Wernigerode and will be named after him. The Museum contains the mineralogical collections of Count Heinrich Ernst, Councillor Jasche and Dr. Döring, the herbarium of Dr. Sporleder, the zoological collections of Dr. Müller and the anthropological collections of Dr. Augustin and Dr. Friedrich.

THE last number of the *Journal* of the Marine Biological Association of the United Kingdom contains the annual report of the Director and of the Council for 1896–97. According to the notice in *Natural Science*, the Plymouth station continues to flourish and increase in utility under the direction of Mr. Allen. The Association is also fortunate in retaining the services of Mr. Holt, for the time being, as Honorary Naturalist. The Lords Commissioners of H. M. Treasury, in granting the usual £1,000 for the year 1897–98, have made it a condition that the Association will give all the assistance in its power to the Inspectors of Irish Fisheries in investigations which they desire to be made on the habits and migrations of the mackerel visiting the Irish coast. This work has thus been begun, and the principal contribution to the new number of the *Journal* is Mr. Allen's report on the present state of knowledge with regard to the habits and migrations of the mackerel (*Scomber scomber*). Most of the other papers also have an important economic bearing. The large laboratory in the Plymouth station has been provided with a new flat tank, eight feet by five feet and eight inches deep, in which Mr. Garstang has been making observations on crustacea. The sea water supplied to the laboratory is still kept distinct from the general circulation in the show tanks, and is never returned to the laboratory tanks after it has passed through them. Experience shows that the theory of 'circulation,' as applied to aquaria, is illusory and in practice disastrous.

THE United States Department of Agriculture has issued a circular by Mr. B. E. Fernow, Chief of the Division of Forestry, on recent legislation on forest reserves. It includes an account of the federal legislation to which during the year we have frequently called attention, and to legislation in Minnesota, Wisconsin, Pennsylvania and New York. In view of the importance of the action of the New York Legislature in enlarging the Adirondack Park, it may be well to give the constitution of the Commission of Fisheries, Game and Forests, under the law of April 25, 1895. This law is a comprehensive measure in which allied interests are brought under the control of a single board. The commission consists of five members appointed by the Governor with the consent of the Senate, the term of office being five years. The President, who is designated as such by the Governor, receives a salary of $5,000 per year and traveling expenses, and devotes all his time to the work of his office. The remaining four commissioners each receive $1,000 per year and traveling expenses. The board holds at least four meetings, on designated days, each year. It has a secretary at $2,000 per year, and necessary clerical force. The duties of the board are to propagate and distribute food-fish and game; to enforce all laws for the protection of fish and game and

for the protection and preservation of the forest reserve. It has full control of the Adirondack Park and forest reserve, and is authorized to make rules for its care and safety. The commission appoints thirty-five 'fish and game protectors and foresters,' one of whom is known as chief, and two others as his assistants, the chief to have direction and control of the entire force. The chief forester receives $2,000 per year and traveling expenses; the assistant foresters $1,200 each; and the remaining foresters $500 each; all having an extra allowance for traveling expenses and each of them to receive one-half of all fines collected in actions brought upon information furnished by them.

THE Cairo correspondent of the London *Times* writes: "The crime statistics for the first three quarters of this year, compiled by the Minister of the Interior, show a gratifying diminution, which is confirmed by the registers of the Ministry of Justice. The figure has fallen from 1,493 cases in the corresponding period of 1896 to 1,143—a decrease of over 23 per cent.; and robberies with violence, which constitute the most serious class of crime in Egypt, have diminished from 476 to 287, or nearly 40 per cent. The fact that the decrease is distributed generally over the country and has occurred steadily month by month shows that it is due, not to any accidental circumstances, but to better organization and control, and indicates a real advance in the state of public security throughout the country."

UNIVERSITY AND EDUCATIONAL NEWS.

PRESIDENT MCKINLEY will deliver the oration on 'University Day,' to be observed by the University of Pennsylvania, on Washington's Birthday.

THE Association of Colleges and Preparatory Schools in the Middle States and Maryland will meet this year at Vassar College, Poughkeepsie. On November 26th and 27th Professor Ralph S. Tarr and Mr Charles C. Wilson will introduce the discussion of science in the schools, which is assigned an important place on the program.

AT the annual meeting of the Council of New York University, on November 1st, Chancellor MacCracken presented a report covering the work of the University for the past twelve years. It appears that when Dr. MacCracken first became connected with the University, in 1885, the value of its property was only about $600,000, whereas it is now nearly $2,500,000. The gifts last year amounted to more than $250,000.

THE Teachers' College, New York, shows a marked growth this year, the number of students being two hundred and forty-one, against one hundred and twenty-nine last year.

IT is expected that a Hall of Physics will be built at Syracuse University next year, the sum of $25,000 having already been subscribed for the purpose.

AT the last meeting of the Board of Trustees of the University of Alabama Mr. George S. Wilkins (Princeton) was elected professor of civil and mining engineering, and Dr. John Y. Graham (Princeton) professor of biology.

DR. FRANK K. CAMERON, late associate professor of chemistry in the Catholic University of America at Washington, has been appointed research assistant in physical chemistry in Cornell University.

DR. WARNER FITE, assistant professor of philosophy in Williams College, has been appointed to a docentship in philosophy in the University of Chicago, and Mr. A. F. Buck and Miss Jane Downey have been appointed assistants in the psychological laboratory.

THE chair of philosophy and the chaplaincy of Lehigh University have been filled by the election of the Rev. Langdon C. Stewardson, rector of St. Mark's Episcopal Church, Worcester, Mass.

DR. MAX VON FREY, of Leipzig, has been called to the chair of physiology at the University of Zurich, and Dr. George Kraus to the chair of botany in the University of Halle, as successor of Professor J. von Sachs.

DR. MAX DESSOIR has been promoted to an associate professorship of psychology in the University of Berlin, Dr. Lothar Heffter has been made associate professor of mathematics at the University at Bonn, and Dr. Brikencajer

associate professor of mathematics at the University of Krakau.

DISCUSSION AND CORRESPONDENCE.

HOW TO AVOID THE DANGERS OF FORMALIN.

TO THE EDITOR OF SCIENCE: In the issue of SCIENCE for October 22d I note a letter by Dr. Dall, of the United States National Museum, in which the use of formalin for the preservation of zoological objects for dissection is declared to be dangerous to the cuticle, to the digital neural terminals and to the eyes of the dissector.

When working with formalin my eyes and nasal passages have been affected and it seemed to me that its use might be fraught with some danger. But the effect of the gas arising from specimens and of the solutions has never given in my case such serious trouble as seems to have been given the person of whom Dr. Dall speaks. To be contrasted with the effects of the reagent in this case is the fact that formalin and formaldehyde have come to be regarded as very important germicidal disinfectants to be used in inhabited rooms, where, we are told by members of the medical profession to which Dr. Dall appeals, that their use need not endanger in any way the inhabitants. Special lamps are on the market for generating formaldehyde from wood alcohol, and to be used in just such rooms. There may also be noted an experiment performed upon a calf, in which the animal was exposed for five hours to an atmosphere containing about 2% of formaldehyde. The only noticeable effect was a slight cough and a slight watering of the eyes, both of which disappeared upon bringing the animal into fresh air. What might have happened had the animal been subjected to such an exposure daily for several weeks is a question that remains to be solved. In view of the fact that formalin seems destined to be used to a very great extent in laboratories and museums, and also in view of its having been recommended as a disinfectant to be used as noted above, experiments to determine how great an exposure eyes, cuticular organs and mucous membranes can stand without injury can have nothing less than a very great importance.

But even though the use of the reagent is as dangerous as the case of the slug dissector mentioned by Dr. Dall would lead one to think, such dangers may be obviated by taking advantage of the strong affinity formaldehyde and ammonia have for one another. In rooms where formaldehyde is used dishes of ammoniated water may be placed, and specimens preserved in formalin may be washed in ammoniated water before dissection, with the result of completely neutralizing the effects of the disinfectant or preservative.

F. C. KENYON.

WASHINGTON, D. C.

PROFESSOR CATTELL'S REVIEW OF 'SIGHT.'

I RARELY ever reply to any criticism of a work of mine. I never do so unless to explain something misunderstood. But in the case of Professor Cattell's review of 'Sight' in SCIENCE for September 24th, I feel the less hesitancy because of his generous estimate of its value. There are three points on which I wish to explain myself more fully.

1. Professor Cattell objects to my view that "the central spot is necessary to the development of the higher faculties of the mind," and asks in rejoinder: "May not the mental faculties of the born-blind be developed?" And well might he object if I implied anything so absurd. But he has entirely mistaken my meaning. Perhaps I am partly responsible for a possible ambiguity, and, therefore, thank him for drawing my attention to it. I did not mean development of the higher faculties in the *ontogeny*, but in the *phylogeny*, of man; not in the education of the *individual*, but in the origin of the *race*. Perhaps, however, I ought to have used the word *evolution* instead of development. I shall make the correction.

2. Again Professor Cattell objects to my saying: "We see things double except under certain conditions." He says: "This is bad psychology. We *learn* to see them double." Of course, we learn to consciously see them double. But if we see only what we consciously see, we see comparatively little. The phenomena of double vision lie so near the surface of consciousness that the least attention recalls them. They may be called subconscious, but we base our judgments on them all the time. Surely it is the business of psychology to bring

into clear consciousness phenomena which underlie so much of our daily conduct.

3. The last point which I wish to touch is again the much discussed question of *upright vision*. I feel like apologizing for bringing up this question again; but I am convinced that much of the difference of view is the result of misunderstanding. For example, I explain upright vision by the *law of direction*. Now, surely, Professor Cattell must misunderstand the explanation when he talks of standing on one's head and still seeing things upright as controverting that law. The law of direction explains uprightness equally well, whatever be the position of the observer. I am sure the question has been obscured and the mystery intensified by that wonderful inverted retinal image. But seeing things upright is not necessarily connected with an inverted image. It is easy to imagine an eye so constructed that the retinal image shall be upright, and yet by the law of direction the object shall also be seen upright. We probably have something like this realized in the case of insects. The compound eye of insects is so constructed of slender tubes lined with pigment that only the central rays of each radiant pencil can reach and impress the retina, all others being quenched by striking on the sides. This, as shown by the figure, would make an upright

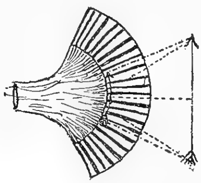

FIG. 1. Diagram showing the upright image in the eye of an insect.

image, and yet by the law of direction the object would be seen upright also. Our retina is *concave* instead of convex. It is so because the image is inverted, and, therefore, must be reinverted in the act of outward reference.

The marvellousness of the inverted image has diverted attention from the real question, which is, the seeing things in their true places. A child only a few days old will turn the eyes toward a bright light. Is there anything so mysterious in this? But why *toward*, unless it saw the light in its true direction? Now, upright vision is only a case under this more general fact; for objects are made up of an infinite number of lights or radiants and each is seen in its true direction, and, therefore, the object in its true position.

Professor Cattell refers to the recent experiments of Dr. Stratton* as controverting the law of direction, although he thinks a much easier way of doing so 'is to stand on one's head.' I am glad to have the opportunity to express my admiration of these experiments of Dr. Stratton, and my high estimate of their value; and I cannot think that the simpler mode suggested by Professor Cattell would be at all an adequate substitute. In brief, the experiment consists in the wearing of inverting glasses continually for eight days. The experimenter for that length of time never saw things except reversed. The ground was above and the sky below, things on the right were seen on the left, and *vice versa*. And yet by the end of the experiment all the movements of the body were so adjusted to the new conditions that he could walk the streets with comparative comfort.

This seems very extraordinary, and it is possible that we may have to reconstruct some of our fundamental conceptions of space; but evidently it does not controvert the law of direction. If we only think a moment, we shall see that we already have phenomena approaching in various degrees the extreme conditions of this experiment, but they are so familiar that they do not strike us with wonder. In looking in a mirror one image is *partly* inverted, *i. e.*, it is turned about a vertical axis—it is inverted from side to side, but not up and down. And yet, we easily adjust our movements to the changed conditions. We make complex movements, such as tying a cravat, with ease and accuracy.

Again, in looking through a microscope the image of the object is *completely* inverted, *i. e.*, it is turned about the visual axis 180°; and, yet, with a little practice, we adjust our movements to the new conditions. We slide the object in all directions accurately and even

* Psych. Rev. for July and September.

automatically, although to do so we must move it in a direction exactly contrary to what the image seems to require.

Now, Dr. Stratton's experiment goes one step farther. In this, not only an object, but the *whole external world*, including the visible parts of the body, are inverted. Not only some, but *all* our movements must be readjusted. The results are certainly surprising and may possibly require some reconstruction of fundamental conceptions of space—how much I am not prepared to say, but they certainly do not affect the law of direction properly understood.

The law of direction gives nothing but *the direction of the impressing force*, and this it gives always. Under *normal* conditions, *i. e.*, when the light comes straight, and without deviation from the object to the eye, it gives the true places of objects and radiants, and therefore upright vision; but not under *abnormal* conditions of deviation of the light. For example, we look at an object in a mirror inclined 45° to the line of sight. The apparent object is seen far away, 90°, from its true place; but this does not violate the law of direction, but confirms it. We see in the direction of the impressing force, which in this case—in all cases—is the *last direction of the light*. Again, in gazing at an object through a microscope, we see it inverted, *i. e.*, the radiants are seen in wrong places. But this does not violate the law of direction. We still see every radiant in the direction of the impressing force, but that direction has been changed so as to give wrong places.

So in Dr. Stratton's experiment. At first, at least, we see things in wrong places, *i. e.*, wrong as judged by the deliverances of other senses, but yet in strict accordance with the law of direction, *i. e.*, in the direction of the impressing force. As to the final result of an indefinite continuance of these experiments and whether complete accord in the deliverances of all the senses would ever be reached, so that things would again seem natural as they do now, this seems to me a question of philosophy rather than science, or, perhaps, I should say of psychology rather than physiology. I am not now concerned with it.

But it must be clearly understood that the law of direction is purely a *formal* law, *i. e.*, a law which groups consistently all the facts concerning the relative places and positions of objects in the external world *as we know it.* This is all that it pretends to do. The discovery and announcement of such general formulæ is the main function of science. As to what the external world is, and what space and direction are, that is another matter. These more ambitious questions belong to philosophy, not to science.

In conclusion, I have said that the law of direction is inherited, not acquired. By this I do not mean that in the last analysis it is not due to experience. It does, indeed, come from experience, but not mainly from *individual* experience. It is the result of *ancestral* experience, inherited all along the line of evolution ever since eyes were formed, and finally embodied in brain structure.

JOSEPH LE CONTE.

BERKELEY, October 11, 1897.

WHEN an author replies to a reviewer it is but courteous for the latter to try to show that he has not been careless in his statements.

1. Professor Le Conte's statement (page 78), "I believe that the existence of the central spot is necessary to fixed, *thoughtful attention*, and this again in its turn is necessary for the development of the higher faculties of the mind," I understood to refer both to individual development and to race evolution. The limited field of distinct vision and the associated eye-movements seem to me factors or correlates in the evolution of attention, but by no means 'necessary.' That is a dangerous word to apply to nature, which works in many ways. Most men may be 'visuals', but some of us are 'motiles'; the horse is an 'audile,' the dog an 'olefactor'. As a matter of fact, Professor Le Conte makes a mistake in stating that the 'central spot * * * exists only in man and in the higher monkeys' with a foot-note to the effect that in different forms it is found in some birds. Knox in 1823 described the central spot and fovea in lizards and they have been found in fishes by Carrière, Krause and others. A central spot, *i. e.*, an area of acute vision, has been described in nearly all mammals, though the fovea is probably only present in the pri-

mates.* Professor Le Conte maintains not only that "the fovea is necessary to the concentration of the attention on the thing looked at," but also (p. 302) that "the existence" of the fovea is determined by "the habits of the animal, especially in looking attentively."

2. I regard it as either bad psychology or bad terminology to say: "We do, indeed, see all objects double except under certain conditions." We do not hear each of the overtones of a tone because most people can learn to distinguish them, nor do we know the motives of our actions because we believe that motives exist.

3. I am glad that Professor Le Conte here calls attention to the real psychological problems involved in localization in the field of vision and in the coordination of visual and motor perceptions. The section in his book which I criticised is, however, headed 'Erect Vision,' and he writes: "How, then, with inverted retinal images, do we see objects in their right position, *i. e.*, *erect?* This question has puzzled thinkers for many centuries," etc. The question seems to me analogous to that of the child who asks how people in China with their heads down can hang on by their toes. It may be a popular paradox, but I do not admit that it is a question deserving serious scientific discussion. J. McKEEN CATTELL.

* For the most recent work on the subject cf the thesis by Dr. Slonaker in the *Journal of Morphology* XIII., 3. Professor Le Conte himself in a later chapter refers to a more highly organized central area in the lower mammals.

A SIMPLE METHOD OF COMBINING THE COLORS.

THE following very simple method of illustrating the recomposition of the spectral colors into white light has some obvious advantages in the way of ease of apprehension on the part of the beginning student. It also possesses an additional and not inconsiderable advantage in that it is striking.

A rectangular refraction tank with glass ends is set up in front of the lantern, both being preferably upon a rotating stand. From a horizontal slit a beam is projected and the prism interposed in such a manner that there is sent down into the water the rays of the spectrum, their order from red to violet running lengthwise of the tank. A few drops of milk are mixed with the water, and with care a mixture may be obtained which in a side view shows the separated rays clearly, while at the same time if viewed from the end of the tank it looks quite white. On cutting off either the violet or red end of the spectrum the end view becomes colored.

If a strong beam is available it is better to turn it back toward the lantern by a reflector before sending it through the prism. This brings the violet rays which are least intense nearest the end, where they have to traverse a thinner stratum of the mixture.

F. W. McNAIR.

MICHIGAN COLLEGE OF MINES.

SCIENTIFIC LITERATURE.

Report of Explorations in the Labrador Peninsula along the East Main, Koksoak, Hamilton, Manicuagan and the Portions of Other Rivers in 1892–93–94–95. By A. P. LOW, B. Ap. Sc. Annual Report of Progress, Geological Survey of Canada, Vol. VIII., pp. 385.

One of the most interesting and valuable reports which has been issued by the Geological Survey of Canada in recent years has just appeared on the peninsula of Labrador, by Mr. A. P. Low.

The report embodies the results of four years' exploration, during which time Mr. Low has traversed Labrador from north to south and from east to west, and it presents in readable form a summary of our knowledge, not only of the geography and geology, but also of the climatology, botany, zoology and natural resources of this remotest part of the Dominion, the interior of which, prior to Mr. Low's exploration, was practically unknown. Mr. Low's work, the results of portions of which have been previously published in preliminary reports to the Geological Survey, and in papers presented to various scientific societies, has attracted much attention and has recently been accorded an especial recognition by the Royal Geographical Society of England. The report is accompanied by a fine map of Labrador, in four sheets, on a scale of 25 miles to the inch, which is colored geologically along the lines

of traverse, and it is illustrated by a number of views showing the character of the country, among them one of the Grand Falls of the Hamilton River, concerning which there was so much discussion a few years since.

The peninsula may be described as a high rolling plateau having a general elevation of from 1,600 to 1,800 feet, the surface sloping rapidly down towards the Atlantic and Gulf of St. Lawrence, but much more gently toward James Bay. To the north of Nain the high land of the coast rises in sharp unglaciated mountains to the height of from 2,500 to probably 6,000 feet.

One of the most remarkable physical features of the country are the deep cañons or fjords followed by all the rivers draining the interior where they cut through the margin of the peninsula and run out to sea. These have rock walls from 1,000 to 4,000 feet in height, while the river channels are from 10 to 100 fathoms deep. They appear to be valleys of deundation and are of very ancient origin, antedating the Cambrian, undisturbed horizontal beds of this age being found deposited upon their lower levels. The gorges of the Hamilton, Sandwich and Kaipokok might be cited as examples, as well as those of the Moisir and Saguenay, discharging into the Gulf of St. Lawrence.

About nine-tenths of Labrador is underlain by rocks of Laurentian age, and, like all the rest of the glaciated Laurentian country, the plateau is studded with myriads of lakes, great and small, which are estimated to occupy at least one-fourth of the total surface, and which are drained by a network of streams discharging into the deep fjords above referred to. The peninsula is underlain exclusively by the oldest rock systems of the earth's crust, the Laurentian, Huronian and Cambrian, besides certain rocks of intrusive origin. The Laurentian rocks differ in no essential particular from those found elsewhere in Canada. Both the Fundamental Gneiss and the Grenville Series are largely represented, the latter running in wide and persistent bands across the country and consisting of micaceous gneisses and schists, quartzites, crystalline limestone, etc., often holding graphite. Great anorthosite intrusions cut these rocks, and from certain of these intrusions is derived the precious labradorite.

The Huronian is represented by several widely separated areas of clastic and volcanic rocks, together with many basic eruptives. They consist of schists of various kinds, with conglomerates, breccias, diorites and other rocks. The Laurentian and Huronian are intensely folded, the folding having taken place at a time long prior to the deposition of the sedimentary beds of Cambrian Age, and a sufficiently long time had elapsed, as has been mentioned, between the period of folding and the Cambrian submergence to permit of enormous denudation and erosion.

The Cambrian strata, which rest uncomformably upon the Laurentian and Huronian, consist of bedded sandstones, argillites, shales and limestones, along with bedded traps and other volcanic rocks and enormous deposits of excellent iron ore, whose mode of occurrence is closely analogous to that of the iron ores of Michigan and Wisconsin.

The surface of the country is mantled with drift, and there is distinct evidence that the whole Labrador peninsula, except a narrow strip of very high land along the North Atlantic coast, was completely buried in ice during a portion at least of the glacial period. The movement of the ice was outward in all directions from a central gathering ground. The position of this névé field was about midway between the east and west coast of the peninsula and between latitudes 53° and 55°, and the area is now characterized by the presence of partially rounded boulders and angular blocks of rock scattered over hill and hollow. Most of these repose on rocks of the same petrographical character as themselves and have evidently been transported but very short distances from their original positions. They probably represent boulders of decomposition but slightly modified by subsequent ice action.

The various sorts of drift and the forms assumed by the drift are described, although a detailed study of these was impossible, owing to the dense forest growth which covers the greater part of the area. There is distinct evidence of a past glacial uplift, which, however, it is believed was not equal all around the coast,

being about three times as great on the south and west margins as along the north and east coast, where two hundred feet appear to be the limit of raised marine terraces and beaches. Appended to the report are lists of the mammalia, birds, food fishes and plants found in Labrador, as well as an appendix by Mr. Ferrier on the microscopical structure of some of the rocks collected, and one by Mr. Eaton on the meteorology of the peninsula.

FRANK D. ADAMS.

McGILL UNIVERSITY, MONTREAL.

L' Evolution de commerce dans les diverses races humaines. Par CH. LETOURNEAU, Professeur à L' École d' Anthropologie. Paris, Vigot Freres. 1897. Pp. 581.

Professor Letourneau has made it his special branch to write about the development of arts and institutions. In the volume before us he takes up commerce, and aims to show its beginning and its growth in the various races and nations of humanity. Beginning with animals of lower species he is obliged to acknowledge that he finds no traces of commerce among them, and tells but one doubtful story of the possible interchange of values between a bird and a man.

In the lower races he discovers still little which is really commerce. When they give in exchange they appear to think each party makes a true gift to the other, and the mercantile idea is not present. Perhaps here he overlooks a peculiarity of human nature which exists in the highest as well as the lowest civilization. There is, for instance, a sort of pride which while expecting exchange on equal terms declines to recognize it as such. It is illustrated in the American custom of 'treating.'

Leaving this aside, the author pursues his investigations among the negro races of Papua and Africa, discovering in them a strong commercial instinct. In Polynesia he recognizes a widespread commerce, but his chapter on that of Ancient America is very much short of what the reader has a right to expect. The authorities whom he quotes are mostly second-hand, such as Prescott and Bancroft, and he does not seem to be acquainted with the valuable articles of Professor Rau on this topic. Hence we are not surprised to find on page 173 the assertion that the Indians considered commerce of the least possible importance; whereas, every one acquainted with the facts knows that it was one of their most active avocations.

He is more at home when dealing with the early commerce of China, Japan, Egypt and the Arabs, who next occupy his attention. Of their activity in this direction he presents a well written sketch. The classical epochs of Greece and Rome are described in their commercial relations, and from them he passes on to mediæval and modern life, of which he gives a hasty outline. His final chapter is intended to embrace the survey of his results and the forecast of what commerce may be in the future. In this prophetic utterance he indulges in some of those dreams of a possible future society with which he delights to amuse his readers, but for which he acknowledges his hopes are faint.

The work is well printed and has a carefully arranged table of contents and a sufficient index.

D. G. BRINTON.

How to Know the Shore Birds (Limicolæ) of North America. By CHARLES B. CORY. Boston, Little, Brown & Co. 1897. Small 4to. Pp. 89. Price in paper, 75 cents.

How to Know the Ducks, Geese and Swans of North America. By the same author and publisher. Pp. 95. Price in paper, $1.00.

These publications are a departure in the way of ornithological literature. Each consists of a key, with figures of heads, bills and tails, followed by plain descriptions of the species, with additional illustrations and a paragraph or two on the range and eggs. The illustrations are half-tone reproductions of wash drawings by Edward Knobel, and while not equal in artistic merit to those of Fuertes, Ridgway or Thompson are excellent for purposes of identification, and some are admirable as pictures, particularly the one of a group of Labrador ducks. In the case of the shore birds, where the beginner is often confused by strikingly different seasonal plumages, both summer and winter dress are shown; and in the case of the water birds having different sexual plumages, pictures of both male and female are given.

The keys do not conform to the modern

'dichotamous' system, now so generally and so deservedly popular. They are based primarily on length of wing, and there are usually several successive categories of equal rank. The objections to this arrangement are partly overcome by the use of very large type for the main headings.

The books are intended primarily for sportsmen and others "who are interested in birds and would like to know their names, but often find it no easy task to identify them by the 'bird books.'" That they fulfill this purpose admirably will be evident to all who use them. The paper and press work are good and the prices remarkably low.

Mr. Cory has made many contributions to ornithology, the most important of which relate to the 'Birds of the West Indies.' His entertaining 'Hunting and Fishing in Florida,' published about a year ago, gained him a wider circle of readers, but it is doubtful if any of his writings will prove so helpful to so large a class as the two that form the subject of this review.

C.H. M.

Les gaz de l'atmosphère. Par H. HENRIET. Paris, Gauthier-Villars et Fils; Masson et Cie.

This short treatise presents the reader in concise form a great deal of useful information with regard to the composition, methods of analysis, and rôle played by the various constituents, of the atmosphere. While the references to recent work would seem to indicate that the book is abreast of the times, the fact that, with few exceptions, the investigations noted are those by French scientists only is not calculated to inspire confidence in the author's conclusions. In the text, although the names of others than Frenchmen occasionally appear, there is no reference to any paper not printed in a French journal. In a bibliography whose length should guarantee its completeness, there is the title of one English book and that of one Italian memoir; the remainder are all French. On the other hand, as the book is evidently written for Frenchmen, it may be that the author gave only such references as would be readily available in almost any public library in France. On the whole, this defect will militate against the use of M. Henriet's convenient little book by others than his fellow-countrymen.

W. W. R.

Argon, a New Constituent of the Atmosphere. By LORD RAYLEIGH and PROFESSOR WILLIAM RAMSAY. Washington, The Smithsonian Institution. 1896.

This paper is published by the Smithsonian Institution in the form in which it was presented in competition for one of the Hodgkins Fund prizes. It remains but to notice that it differs from the abstract which appeared in the *Proceedings of the Royal Society*,* in that it contains detailed accounts of experiments and results omitted in many cases from the abstract; and from the fuller paper in the *Transactions*,† since the latter incorporates the results of later experiments in several directions.

It may be as well to call attention to a typographical error in the formula (p. 35) which indicates the relation between the velocity of sound in a gas and the ratio of the specific heats: 'N' should be '$\sqrt{\ }$' W. W. R.

Atmospheric Actinometry and the Actinic Constitution of the Atmosphere. By E. DUCLAUX. Washington, The Smithsonian Institution. 1896.

This paper is a translation of that presented by M. Duclaux in competition for one of the Hodgkins Fund prizes. It represents an endeavor to measure the quantity and effect of the actinic solar rays, as distinguished from the luminous and calorific, under varying atmospheric and climatic conditions.

The reagent employed for these measurements is a solution of oxalic acid; this is rapidly oxidized by actinic rays, is not affected by the luminous rays and scarcely at all by the calorific, while the reaction is but slightly exothermic. From the summary of results the following may be noted as of special interest: The 'daily combustion' varies from one day to another much more than any other meteorological phenomenon. It shows the influence of the seasons and manifestly exhibits a maximum in the

* Vol. 57, p. 265. This paper also was published in this country, *e. g.*, *American Chemical Journal*, Vol. 17, p. 225.

† Vol. 186, p. 187.

spring. It is but feebly subject to the influence of altitude. So sensitive is it to the presence of oxidizable substances in the air that daily and local variations must be due to the existence in the atmosphere of 'actinic clouds' otherwise undiscoverable. In northern latitudes the atmosphere is less absorbent of actinic rays and hence that kind of radiation is more active relatively than in lower latitudes. The actinic effect of the sun increases more rapidly than the duration of its presence above the horizon; as a result, the effect produced during the long days of the northern summer is proportionally very great. The actinic effect may continue after the luminous effect of the sun's radiation has become clouded; thus the effect of a fine morning is not lost by a dark and cloudy evening. The duration of the day and the solar effect as usually measured are of little value for calculating the true actinic effect of sunlight. The paper as a whole is of unusual interest.

W. W. R.

SOCIETIES AND ACADEMIES.

KANSAS ACADEMY OF SCIENCE.

THE thirteenth annual meeting of the Academy was held at Baker University on October 27th, 28th and 29th, under the presidency of Professor S. W. Williston.

The scientific program was as follows:

The migrations of birds.........................J. R. Mead
A list of the Goss Ornithological Collection, being the report of the Board of Curators....D. E. Lantz
A Bibliography of Kansas ornithology, with an historical list of Kansas Birds...........D. E. Lantz
A list of the birds taken in Mexico and Central America by the late Colonel N. S. Goss, with notes of localities...........................D. E. Lantz
An historical list of Kansas mammals.......D. E. Lantz
The injurious insects of the year in Kansas......... S. J. Hunter
Kansas *Lachnosterna*.........................Warren Knaus
Entomological collecting notes...........Warren Knaus
Observations on the elm-twig girdler................ Percy J. Parrott
The natural history possibilities of Belvidere, Kansas.......................................C. N. Gould
An inexpensive dissecting-stand for microscopical dissections.................................S. J. Hunter
Biological notes................................S. J. Hunter
A floral horologue for Kansas..............B. B. Smyth
Root tubercles and their production by inoculation..D. H. Otis
Therapeutical notes on some Kansas plants......... L. E. Sayre
Notes on Kansas plants..................A. S. Hitchcock
Bibliography of literature relating to wind effects on trees.................................J. B. S. Norton
On the finding of insects in the Comanche Cretaceous of Kansas............................C. N. Gould
Fusulina cylindrica shell structure........Alva J. Smith
Range and distribution of the *Mosasauria*.......... S. W. Williston
A new *Labyrinthodont* from the Kansas Carboniferous..................................S. W. Williston
Geological notes on Trego County and vicinity J. W. Beede
A preliminary report on the geology of the Delaware Valley in Atchison County.....J. W. Wilson
New developments in the Mentor beds...C. N. Gould
Extremes and means of Kansas climate....F. H. Snow
Viscosity of the ether...................A. St. C. Dunstan
Alternating currents in a Wheatstone bridge where branches contain resistance and capacities.......................................Martin E. Rice
Equilibrium of forces in a flim originally spherical, grounded in the presence of an external electric charge...............................L. I. Blake
Some problems of marine telephony without wires...L. I. Blake
The dehydration of gypsite...............E. H. S. Bailey
Some new mineral waters.................E. H. S. Bailey
Decomposition of some diazo compounds with methyl alcohol..........................Geo. F. Weida
On the generation of finite transformations from infinitesmal transformations..........H. B. Newson
Additional notes on the timbered mounds of the Kaw Reservation..........................C. N. Gould
Relativity in science............................E. B. Knerr

The subject of the President's address was 'Science and Education.'

NEW BOOKS.

Allgemeine Erdkunde. I. HANN, ED. BRÜCKNER and A. KIRCHOFF. II. part, fifth edition. Prag, Wien and Leipzig, F. Tempsky. 1898. Pp. xii+368. M. 8.

Das kleine botanische Practicum für Anfänger. EDWARD STRASBURGER. Third edition. Jena, Gustav Fischer. 1897. Pp. viii+246. M. 6.

Nature Study in Elementary Schools. MRS. L. L. WILSON. New York and London, The Macmillan Co. 1897. Pp. xix+262.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; C. E. BESSEY, N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; C. S. MINOT, Embryology, Histology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, NOVEMBER 19, 1897.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N Y.

*THE IMPORTANCE OF ASTROPHYSICAL RESEARCH AND THE RELATION OF ASTROPHYSICS TO OTHER PHYSICAL SCIENCES**

THE domains of the physical sciences are not, like the political divisions represented on a map, capable of being defined by boundary lines traced with mathematical precision. They pass into one another by imperceptible gradations, the unity of nature opposing itself to rigid systems of classification. Thus there often exists between two allied sciences a broad ground, belonging to each, yet exclusively the property of neither, which may be so extensive and fertile as to justify the development of a new science for its special cultivation. And such a science not only subserves the purpose for which it was created, but it has the further special importance that, by promoting an exchange of knowledge between its previously established neighbors, by investigating the cause of disagreements between them, by comparing their methods, and possibly by detecting errors in their results, it tends to bring them into more perfect coordination.

Such is the nature of the science which Professor Langley has called the new astronomy, and which is also, and perhaps more generally, known as astrophysics. Its

*Address delivered at the dedicatory exercises of the Yerkes Astronomical Observatory, of the University of Chicago, Williams Bay, Wis., Thursday, October 21, 1897.

high development has in fact been so recent that its name is found in only our latest dictionaries. It is closely allied on the one hand to astronomy, of which it may properly be classed as a branch, and on the other hand to chemistry and physics; but it assumes wide privileges, and it is ready to draw material which it can use with profit, from any source, however distant. It seeks to ascertain the nature of the heavenly bodies, rather than their positions or motions in space—*what* they are, rather than *where* they are; and for my own convenience I shall use the terms astrophysics and astronomy to denote the sciences of which these aims are respectively characteristic. Yet here again the line of demarcation cannot be sharply drawn, since the measurement of celestial motions that cannot be dealt with by the methods of the older astronomy is one of the most important tasks of the astrophysicist. That which perhaps is most characteristic of astrophysics is the special prominence which it gives to the study of radiation. The complex nature of white light, in particular, is never lost sight of, and its consequences are thoroughly exploited.

That the older astronomers made no efforts systematically to study the nature of the heavenly bodies, is to be ascribed to the seeming hopelessness of such an attempt in their day, rather than to a lack of interest in the subject, or a slight appreciation of its importance, on their part. They did, in fact, seek explanations of such phenomena as they could observe, and the beginnings of astrophysics are to be found far back in the past. But the curious speculations of Sir John Herschel on the structure of the sun's photosphere show how inadequate was the supply of facts to serve as a basis for a science of solar physics in Herschel's time. The conception of living organisms a thousand miles long, floating about on the sun's surface, and shining with the intense brilliancy of the photosphere, seems to us extraordinary, and even grotesque. To lose its strangeness it has to be considered with reference to the contemporary state of knowledge. But the fact that only fifty years ago it was regarded as an admissible supposition by one of the most eminent of astronomers helps us to realize how rapid has been the advance of astrophysical science. It was only after the discovery was made, that the light which reveals to us the existence of the heavenly bodies also bears the secret of their constitution and physical condition, that the basis for a real science was obtained. The spectroscope placed new and hitherto undreamed-of powers in the hands of men. It is to the astrophysicist what the graduated circle and the telescope are to the astronomer.

The study of astrophysics does not at present seem to have a very direct bearing on the practical affairs of everyday life. If to this statement the objection should be made that the study of solar radiation is likely to lead to a practical method of utilizing the sun's heat as a source of mechanical power, I should say that such a discovery (if it is ever made) is much more likely to be the result of an ingenious application of principles already known. What the future may have in store we cannot tell, but at present the statement I have made holds good. With respect to practical usefulness, therefore, astrophysics does not possess the same claims to consideration as astronomy, which has obviously important applications in furnishing standards of time, and in surveying, geodesy and navigation, and in addition to these, an immense indirect influence on thousands of ordinary affairs. Yet on such grounds it is not probable that any astronomer would care to base a claim for his science. Astronomy long ago reached that state of perfection which suffices for the practical ends

I have mentioned, and is still pursued with undiminished vigor. Both astronomy and astrophysics take their stand on a higher plane, where it is a sufficient justification for their existence that they enable us better to understand the universe of which we form a part, and that they elevate the thoughts and ennoble the minds of men.

In considering the importance of astrophysical research, I have, therefore, regarded the question from a purely scientific point of view. Even with this restriction there is room for a considerable diversity of opinion, since the elimination of the human element from the question is impossible. Scientists are men. Every man is naturally inclined to attach special importance to that in which he is himself specially interested. Personal preferences, or even prejudices, may enter into the estimation in which a branch of learning is held. But, setting these aside, there are grounds for differences of opinion which are entitled to respect. What importance is to be attached, for example, to the proof, now brought almost within our grasp by the improvement of spectroscopic instruments and methods, that the law of gravity is operative within the stellar systems, as well as in the system of our own sun? Doubtless there are some who are satisfied with the moral certainty that we already possess, and to whom the proof just mentioned would merely afford the satisfaction of inking in, on a printed form, the penciled words which had already been written in its blanks; while there are others who would regard the formal proof as alone entitled to consideration. I have even heard widely different opinions expressed by eminent astronomers as to the scientific importance of a problem so fundamental as the exact determination of the distance of the sun.

The degree of importance which we attach to a newly discovered fact or principle is influenced by many circumstances, among which we cannot fail to recognize some of the failings of human nature. When progress is rapid, individual achievements lose their prominence, like mountain peaks rising from a high plateau. The discovery of an asteroid was once a notable event. Now it attracts little attention, outside of a small circle of observers, and it is probable that few of us could say just how many of these little bodies have been brought to light during the past year. In astrophysics discoveries of the highest significance have succeeded one another so rapidly that they are now taken as a matter of course.

The bearings of a discovery on existing knowledge are sometimes not immediately perceived, and its true scientific importance is not appreciated until these are revealed in the fullness of time. Other circumstances might be mentioned, but these are sufficient for my purpose, which is to show that there is no cause for surprise if opinions differ as to the exact value of astrophysical research. It is because the science of astrophysics is so young—so distinctly in the formative stage—that I have ventured to discuss a question which, in due time, will settle itself.

A feature of astrophysical research which I do not wish to leave unmentioned is the interest which is felt in it by the public. Those who are interested in the results of science, but who care little for methods, and know nothing of elegant forms of analysis, are naturally more attracted by the view of the heavenly bodies which astrophysics presents than by the view which is obtained from the standpoint of the older astronomy. Astrophysics paints its picture in the brighter colors. A star regarded as a center of attraction, or as a reference point from which to measure celestial motions, awakens little enthusiasm in the popular mind; but a star regarded as a sun, pouring out floods of light and

heat as a consequence of its own contraction, torn by conflicting currents and fiery eruptions, shrouded in absorbing vapors or perhaps in vast masses of flame, appeals at once to the popular imagination. Both branches of astronomy share in the advantages which follow this awakening of popular interest; for that popular interest in any science is to be deprecated is to my mind utterly inadmissible. The cultivation of a pure science is possible only in those communities where such an intelligent interest exists. Without it we should not be here to-day. It is splendidly manifest around us. The only possible danger to be feared is that interest in results whose significance is readily understood may lead to an undervaluation by the public of results which are of the highest importance, but which only the trained specialist can fully comprehend; and this danger will be avoided if scientific men publicly express their own appreciation of results which belong to the latter class.

Popular interest which is not of this character, but which has no purpose other than amusement, is less desirable. "It is the universal law," says Macaulay, "that whatever pursuit, whatever doctrine, becomes fashionable, shall lose a portion of that dignity which it had possessed while it was confined to a small but earnest minority, and was loved for its own sake alone." Macaulay is here referring to a temporary interest in scientific matters which prevailed among fashionable circles in the reign of Charles the Second—to what would now be called a 'fad.' In our own time science occasionally suffers in much the same way. It is to be regretted that the habitability of the planets, a subject of which astronomers profess to know little, has been chosen as a theme for exploitation by the romancer, to whom the step from habitability to inhabitants is a very short one. The result of his ingenuity is that fact and fancy become inextricably tangled in the mind of the ay man, who learns to regard communication with the inhabitants of Mars as a subject deserving serious consideration (for which he may even wish to give money to scientific societies), and who does not know that it is condemned as a vagary by the very men whose labors have excited the imagination of the novelist. When he is made to understand the true state of our knowledge of these subjects he is much disappointed, and feels a certain resentment towards science, as if it had imposed upon him.

Science is not responsible for these erroneous ideas, which, having no solid basis, gradually die out and are forgotten. Thus it cannot long suffer from outside misapprehension, while the sustained effort necessary to real progress is in the end a sufficient safeguard against the intrusion of triflers into its workshops.

In astrophysics sustained effort is as necessary as it is in other branches of science. There is an impression in some quarters that the results of astrophysical investigation are easily obtained. That this is in some cases true may readily be admitted. I cannot regard it as a reproach. It is one of the advantages to which I have referred by bringing new methods to bear on old problems. What an effort to grasp something tangible we observe in the earlier writing on Fermat's principle! What a groping in the dark after a principle felt rather than seen! and how obvious the same principle is from the point of view of the wave theory! In a field so wide and so little explored as astrophysics there must be novelties which can be gathered with comparatively little effort, and which may nevertheless be of no small importance. But there are also problems whose solution calls for the exercise of the highest intellectual faculties, and for the most strenuous exertion.

In astrophysics difficulties are met with

quite different from those of physical astronomy. There a vast variety of highly complex phenomena are to be referred to the operation of a well-known and extremely simple law. The mental discipline there obtained is of the highest order, and it is hardly necessary to say that a training in the methods of the older astronomy should be regarded as an indispensable preparation for astrophysical work. But in astrophysics, as in the sciences of chemistry and biology, there are difficulties which arise from an imperfect knowledge of the laws governing the phenomena observed. The discovery of unknown laws and principles, as well as the explanation of phenomena by laws already known, is one of its most important objects.

I have referred to the differences of opinion which usually exist with reference to the value of a new science. There may be some who view with disfavor the array of chemical, physical and electrical appliances crowded around the modern telescope, and who look back to the observatory of the past as to a classic temple whose severe beauty had not yet been marred by modern trappings. So mankind, dissatisfied with present social conditions, looks back with tender regret to the good old times of earlier generations, yet rushes forward with the utmost speed. May we regard the eagerness of pursuit as a measure of the value of its object? That the importance of astrophysical research, considered with respect both to its own ends and to its bearing on the advance of knowledge in other fields, is already great, and that it will grow steadily from year to year, is naturally my own belief. In a general way I have considered some of the reasons on which it is founded, and I now wish to call your attention to a few specific cases which illustrate my general remarks, and in which I think the importance of astrophysical science is manifest.

Some of the most noteworthy advances in astronomy and in astrophysics have been made possible by the introduction of photography. The photographic plate not only gives a permanent record of what the eye can see, but, by its integrating power continued through long exposures, it builds up a picture from light impulses too feeble to affect the sense of vision. Thus it has been discovered that vast regions in the sky are filled with diffuse nebulæ, which (since the apparent brightness of a surface cannot be increased by any optical device) must ever remain unseen. This information, which the photographic plate alone could furnish, is itself most wonderful and suggestive. It is, however, but a part of what the same plate may yield. Whoever has studied Professor Barnard's admirable pictures of the Milky Way in Scorpio must have observed how accurately the distribution of the smallest stars corresponds to that of the extended nebulosity which fills this part of the sky, and at the same time how strikingly the nebulous matter is concentrated around the brightest stars in the constellation. Bright stars, faint stars and nebulosity are unmistakably physically related, and, hence, at the same order of distance from the earth; and from this it follows that the real sizes of the stars are of entirely different orders. Here is a fact having a most important bearing on the question of stellar distribution, brought out by the simplest possible means. It is perhaps beyond the reach of more elaborate methods. And in this case it is to be observed that the evidence would not be made clearer by any further treatment of the material. The positions of the stars and the density of the nebulosity might be measured, and the results might be tabulated, but all to no purpose; for, if the data yielded by observation were in the form of measurements, the first step toward their interpretation would be the construction of just such a

chart as the photograph places ready in our hands.

Of very great importance to the new astronomy has been the investigation of the conditions of maximum efficiency of its chief instrument, the spectroscope, by the methods of physical optics. The theory of resolving power, introduced by Lord Rayleigh, and quite recently elaborated by Professor Wadsworth, has been especially fruitful. It has done away with the old idea that the efficiency of a spectroscope is measured by its dispersion, and may be trusted to destroy in time some musty traditions concerning the magnifying power and definition of astronomical telescopes. The theory has also been extended so as to include the spectrograph, in which the photographic plate takes the place of the eye at the observing telescope of the spectroscope. The designing of spectroscopes has thus been placed on a thoroughly scientific basis. At the same time the demands for accuracy in the practical construction of the instrument have been greatly raised. The objectives, the prisms, the fitting of the mechanical parts, must be the best possible. Hence the spectroscope has become an instrument of precision, worthy of a place among the most refined instruments of practical astronomy, and fitted for the class of work now most needed in astrophysical research.

A familiar example of the mutual obligations of allied sciences is found in the first measurements of the velocity of light. Perhaps a somewhat parallel case may have to be recorded by the future historian of science. Spectroscopists have tested the validity of what is known as Doppler's principle, by which the motion of a body in the line of sight is determined from the observed displacement of its spectral lines, and have at the same time proved the capabilities of their instruments, by means of the velocities of the earth and heavenly bodies furnished to them by astronomy. It is not impossible that this also is a reversible process, and that measurements of the velocities of bodies in the solar system may give one of the best methods of determining the dimensions of their orbits.

Numerous cases could be mentioned in which astrophysical investigations have contributed to our knowledge of the chemical elements. Of these the first which naturally presents itself is one of the most recent. The element helium was discovered first in the sun (as its name implies), then in the stars, then in the nebulæ, and at last, by Professor Ramsay, it was 'run to earth.' It had an important place in celestial chemistry long before it was known to terrestrial science; and, on account of its rare occurrence and seeming inertness, it is quite possible that but for the spectroscope of the astrophysicist we should have remained forever ignorant of its existence. To the astrophysicist, however, it was known only by the occurrence in its spectrum of one bright line. Laboratory investigations soon revealed its complete spectrum, and then the astrophysicists were able to recognize, as belonging to helium, a large number of lines whose origin in the heavenly bodies they had been unable to discover. Our knowledge of the heavenly bodies may be greatly advanced when the properties of this remarkable element shall have been thoroughly studied.

It is not necessary, however, to seek illustrations in new elements. The complete series of hydrogen lines, to which belong the few lines that are ordinarily seen in the laboratory spectroscope, was discovered by Huggins in the spectra of the white stars; and a new series, which had previously been seen by the eye of theory only, and which, so far as I know, has not yet been produced artificially, has recently been found by Pickering in the spectrum of the star *Zeta Puppis*.

Another familiar element is calcium. Its

ordinary properties are well understood. But under the conditions met with in the sun and stars it behaves in a mysterious manner. Notwithstanding its considerable atomic weight, it floats quietly high above the surface of the sun, where other heavy metals are only occasionally present in consequence of violent eruptions. It is true that the apparently abnormal spectrum of calcium under these conditions has been shown by Sir William and Lady Huggins to be merely the result of extreme tenuity of the luminous vapor; but the existence of calcium at such great heights, under any conditions whatsoever, seems to point to some remarkable property of the element which is unrecognizable by the methods of ordinary chemistry.

The spectrum of a substance is not the same under all circumstances. In some cases a change occurs suddenly when certain critical conditions are reached; in others the change is gradual and progressive. By studying these changes in laboratory experiments, and comparing them with what we see in the observatory, we are able to arrive at some definite conclusions respecting the conditions which prevail in the stars, while the same comparison often throws light on the phenomena observed in the laboratory. It has been shown, for instance, that the spectrum of magnesium gives a means of estimating the temperatures of the stars; and the same criterion enables us to recognize in the stars temperatures vastly exceeding the highest that have been produced on the earth. Thus the science of astrophysics allows us to extend our investigations to temperatures which the resources of the laboratory cannot furnish.

It may be well to mention an example of the difficulties, to which I have referred, arising from our imperfect knowledge of the laws which underlie phenomena constantly observed. Recent comparisons of the spectra of the sun and metals, made at the Johns Hopkins University with the concave grating spectroscope of Professor Rowland, have proved that spectral lines may not merely be widened by increased pressure of the radiating vapor, but that they may be shifted bodily; while the still more recent investigations of Zeeman show that a line may be widened (and at the same time doubled) under the influence of a strong magnetic field. It is true that in both cases the effect produced is very small. It could not lead to mistakes in identifying stellar lines, or to appreciable errors in measuring celestial motions. But the fact that the spectrum of a substance varies according to circumstances which are as yet only imperfectly understood, shows us the necessity of exercising caution in interpreting the spectral phenomena presented to us by the heavenly bodies. At present these spectral variations increase the difficulties that the astrophysicist has to contend with. Eventually they will become additional and most valuable sources of information.

The discovery, by Kayser and Runge, of line series in the spectra of the common elements has a most important bearing on the work of the astrophysicist. It provides him with the means, long greatly needed, of deciding with certainty whether or not lines in celestial spectra are identical with lines in the spectra of terrestrial substances. On the other hand, as we have already seen, he is sometimes able to supply the physicist with missing data.

From the point of view of the old astronomy the most important result of the introduction of the new methods has been the determination of motions in the line of sight by means of the spectroscope. The method has been tested so often, and with such uniform success, that there is no longer any doubt as to the correctness of the principle on which it is based, or to the accuracy of the results which it is capable of yielding

in competent hands. It is directly applicable to one of the great problems of astronomy—the determination of the direction and rate of the sun's drift through space. From the proper motions of the the stars, furnished by the methods of the older astronomy, the direction of the sun's motion can be deduced, and, under certain assumptions as to the stars' distances, the rate of motion; but it is evident that the latter element of the problem must be subject to very considerable uncertainty. With the spectroscope velocities are directly measured in miles per second. The two methods may be combined. It is probable that the most accurate determination of the *direction* of the sun's drift can be obtained by preparing proper motions, while the most accurate value of the *velocity* is that given by the spectroscope. Thus by the coöperation of the two branches of astronomy, there is measured in space a base line of constantly increasing length for a great sidereal triangulation. At present the material afforded by spectroscopic observation is not sufficient for this great work. The observations must be treated statistically, and statistical methods can be applied successfully to only a large mass of data. What is now needed, therefore, is observations of more stars, *i. e.*, fainter stars, and the German government is building a large telescope for the observatory at Potsdam (where photography was first applied to this class of observations), in order that the work may be continued. There is room, however, for the employment of other large telescopes in the same field. The multiplication of observations for this purpose is no more to be deprecated than the multiplication of observations for the exact determination of star places.

Solar physics, from which the wider science of astrophysics has been evolved, offers problems so numerous and so complicated that I cannot even mention them, still less enter into a discussion of their bearing on other branches of knowledge. And what can I possibly say of their importance? The sun is to us the grandest of material objects. It is the source of practically all our light and heat; of practically all our mechanical power; absolutely the support of all our lives. What wonder that we seek for knowledge of its nature by all the ways that we can find! These ways are opened through astrophysical research. In few of the inquiries that I have referred to can the method of light analysis be dispensed with. In most of them it offers the only chance of success.

I have time to mention only one new method of solar research. The most notable contribution to solar physics within the last few years has been the invention of the spectroheliograph by Hale and Deslandres. With this instrument photographs of the sun are taken by strictly monochromatic light, which may be chosen from any part of the spectrum. If the part selected is the middle of the K line, the picture essentially represents the distribution of calcium vapor on the disk of the sun, and the presence of other elements is ignored. This is, in fact, the line usually chosen, partly on account of the conspicuous rôle played by calcium in solar phenomena, and partly for other reasons, which it is not necessary to state. The possibilities of the method are obvious. By an ingenious modification of his instrument Hale now photographs on a single plate the Sun covered with all its spots and faculæ, and surrounded by all its prominences; and all this is done in a few minutes, in full daylight! Could the corona be added, the triumph would be complete; but the corona yet remains unconquered in its stronghold, though the attack is being vigorously pushed.

No branch of observational astronomy seems to be in so backward a state as the

representation of the surface features of the planets. Although the moon has been photographed with splendid success, and the planets with results that are encouraging and suggestive, we still rely (in the case of the planets) on the old method of hand drawing used by Galileo. The fallibility of the draftsman is well known. It has been illustrated again and again. Yet there seems to be a curious habit among some observers of regarding a drawing, when once made, as invested with high authority —as that of a standard established by legislative act. A photograph, if it could be made, would be free from the errors of the draftsman, and from a personality which is recognizable in all hand drawings, and which, though it is scarcely to be classed as an error, it would be desirable to avoid. Here, then, is another opportunity for the new methods. There is no reason to suppose that it is impossible to obtain photographs of the planets which will show all that the eye can see, although there are many reasons to know that it will be very difficult to do so. The instruments for this purpose would have to be quite different from those in general use, and there would be few occasions, in even the most favored regions of the earth, when they could be employed. Difficulties would also arise from the rapid rotation of some of the planets. But this is not the place to discuss the necessary conditions. It is only fair to say that Professor Schaeberle, of the Lick Observatory, has already been experimenting in this direction—with what success is not yet generally known.

Passing to stellar spectroscopy, a field broader even than that of solar physics is opened before us; for the sun, although paramount in his own system, is only one of the stars. In a general way, the spectra of the stars have been observed, and classified according to their character, and objects of unusual interest have been noted for future investigation—many a rare specimen has been meshed in Harvard's widely extended net; but the detailed study of individual spectra has just begun. For this purpose large telescopes are desirable, if not absolutely necessary. Many observations of precision required in the older astronomy are best made with small telescopes. But in stellar spectroscopy light is all-important; and while much can doubtless be accomplished with small telescopes, there is probably nothing that cannot be done better with large ones. Even in solar spectroscopy, where the supply of light is abundant, a large image is required for the study of individual parts of the sun's surface.

No department of astrophysics has profited more by the introduction of photographic processes than stellar spectroscopy. To the advantages of photography already mentioned there is here to be added another not less important. Owing to atmospheric disturbances the image of a star dances about on the slit-plate of a spectroscope placed in the focus of a telescope. The spectrum is not only faint, but tremulous, and to measure the lines in it by visual observation is like trying to read a printed page irregularly illuminated by flashes of light. These irregularities do not appear on the photograph. They disappear in the process of integration. Negatives obtained with the spectrograph can be directly measured under a microscope, or enlargements can be made from them in the usual manner. In this way photographs of star spectra are now made which are comparable, with respect to accuracy and wealth of detail, to Kirchhoff's famous map of the solar spectrum. "It is simply amazing," says Professor Young, with reference to the Draper memorial photographs, "that the feeble, twinkling light of a star can be made to produce such an autographic record of substance and condition of the inconceivable distant luminary."

Let us consider for a moment some of the questions in this field that are open for investigation. The motions in the line of sight of all stars within reach of the largest telescopes have to be measured. This important line of research has already been referred to. The relation has to be ascertained between the various classes of star spectra and the probable order of stellar evolution. It now appears practically certain that all the stars are not made according to a single pattern, and that they cannot be fitted into a single scheme of development. The Wolf-Rayet stars, the stars with banded spectra, the stars with bright-line spectra, the planetary nebulæ, the spectroscopic binaries, the variable stars, require the most careful attention. Variables of the Mira class should be followed with the spectroscope as far as possible from their maximum, and the spectral changes which accompany the light variation of other stars, whether due to phenomena of emission and absorption, or to relative motion of bodies in a revolving system, should be studied with the most powerful instruments.

The discovery, by means of the spectroscope, of binary stars which are far too close for resolution with our most powerful telescopes, and which are recognized in their true character by a periodic doubling of their spectral lines, has brought to our knowledge strange and wonderful conditions of orbital motion. Such a system as that of Spica, where two bodies like our sun revolve around each other like the balls of a gigantic pendulum, in a period of only four days, at a distance no greater than that which separates the sixth satellite of Saturn from its primary, must have remained forever unknown to the older astronomy. Between these spectroscopic binaries and the most rapidly revolving doubles visible in the telescope there is a wide gap, the cause of which is obvious. The conditions favorable to discovery in the two cases are directly opposed, and doubtless a large class of stars lies at present just beyond the reach of either method.

But this gap may be bridged over by means of such a great telescope as we see before us to-day, while the work necessary to accomplish this end will open up still another field for research. It has long been recognized that the position micrometer and the spectroscope, taken together, are theoretically competent to determine the real orbits in space of the components of a double star; hence, also, the masses of the components and their distance from the earth. Until recently the question had only a mathematical interest. But the small velocities to be expected in the case of any double star whose components can be separately distinguished with the telescope are now almost, if not quite, within reach of the spectroscope, and the investigation of such doubles has acquired a physical interest.

Here I must close my review of the important questions before the astrophysicist, with the consciousness that it is most remarkable for what it leaves unnoticed. I have said nothing of questions relating to the photography of comets and their spectra, the rotation of the planets or the absorption spectra of their atmospheres, the colors of double stars, the spectra of temporary stars, the measurement of obscure wavelengths; nothing about stellar photometry, the application of interference methods to spectroscopic research, the exploration of the infra-red spectrum. But I will not trespass further on your patience. In all the fields that I have mentioned there are noble problems, worthy of the best efforts that can be given to their solution. To realize their importance, think how ill we could spare what we have already won. What a blank would be left in our knowledge of the heavens if the results of astro-

physical research in our own generation were stricken out!

The future should look bright, indeed, as we view it to-day. Munificence and skill have provided this splendid observatory with means for promoting knowledge in both the older and the newer branches of the sublime science to which it is dedicated. Its magnificent equipment will be used by men who have won merited distinction in both the older and the newer methods of research. It has the cooperation and support of a great institution of learning. From this happy union of ability and opportunity we have reason to expect results of the highest import to the new astromony, and to its allied branches of physical science.

But, lest any words of mine should give rise to expectations that may not be fulfilled, I wish to say once more that important results are not necessarily of a striking or surprising character. We can hardly assume that every increase in telescopic power will be followed by the discovery of new planets or satellites. Such discoveries, if they come, will be welcome; but they should not be expected. There may be no more planets or satellites, yet undiscovered, in the solar system. But we may confidently expect from the work of this observatory those results which throw light on the dark places in nature, and which, therefore, though they may not stimulate the popular imagination, are of the very highest importance, for they are indispensable to true scientific progress.

JAMES E. KEELER.

ALLEGHENY OBSERVATORY.

MATHEMATICS AND ASTRONOMY AT THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE officers of the Section of Mathematics and Astronomy were as follows: Chairman, W. W. Beman; Secretary, J. McMahon; Press Secretary, P. A. Lambert; Councillor, E. W. Hyde; Sectional Committee, W. W. Beman, J. McMahon, A. Macfarlane, W. F. Durand, J. E. Kershner, W. S. Pritchett; Member of Nominating Committee, A. Ziwet; Committee to nominate officers of Section, W. W. Beman, J. McMahon, A. Hall, Jr., R. S. Woodward, A. Macfarlane.

The Chairman's address was on 'A Chapter in the History of Mathematics,' which has already been published in this JOURNAL.

The following papers were presented to the Section:

1. A Problem in Substitution-groups. By Dr. G. A. Miller, Rosette, Kan.

2. Continuous Groups of Spherical Transformations in Space. By Professor H. B. Newson, Lawrence, Kan.

3. The Treatment of Differential Equations by Approximate Methods. By Professor W. F. Durand, Ithaca, N. Y.

4. Commutative Matrices. By Professor J. B. Shaw, Jacksonville, Ill.

5. On the Theory of the Quadratic Equation. By Professor A. Macfarlane, Lehigh University, South Bethlehem, Pa.

6. A New Principle in Solving Certain Linear Differential Equations that occur in Mathematical Physics. By Professor A. Macfarlane, Lehigh University, South Bethlehem, Pa.

7. Condition that the Line Common to $n-1$ Planes in an n-space may Pierce a Given Quadric Surface in the Same Space. By Dr. Virgil Snyder, Ithaca, N. Y.

8. The Psychology of the Personal Equation. By Professor T. H. Safford, Williamstown, Mass.

9. Compound Determinants. (Preliminary communication.) By Professor W. H. Metzler, Syracuse, N. Y.

10. Waters within the Earth and Laws of Rainflow. By W. S. Auchincloss, C.E., Philadelphia, Pa.

11. On the Secular Motion of the Earth's Magnetic Axis. By Dr. L. A. Bauer, University of Cincinnati, Cincinnati, O.

12. Simple expressions for the Diurnal range of the Magnetic Declination and of the Magnetic Inclination. By Dr. L. A. Bauer, University of Cincinnati, Cincinnati, Ohio.

13. The Theory of Perturbations and Lie's Theory of Contact-transformations. By Dr. E. O. Lovett, Princeton, N. J.

14. On Rational Right Triangles. No. I. By Dr. Artemas Martin, U. S. Coast Survey, Washington, D. C.

15. Some Results in Integration expressed by the Elliptic Integrals. By Professor James McMahon, Cornell University, Ithaca, N. Y.

16. Modification of the Eulerian Cycle due to Inequality of the Equatorial Moments of Inertia of the Earth. By Professor R. S. Woodward, Columbia University, New York.

17. Integration of the Equations of Rotation of a Non-rigid Mass for the case of Equal Principal Moments of Inertia. By Professor R. S. Woodward, Columbia University, New York.

18. General Theorems concerning a certain class of Functions deduced from the properties of the Newtonian Potential Function. By Dr. J. W. Glover, Ann Arbor, Mich.

19. The Importance of adopting Standard Systems of Notation and Coordinates in Mathematics and Physics. By Professor Frank H. Bigelow, U. S. Weather Bureau, Washington, D. D.

20. A Remarkable Complete Quadrilateral among the Pascal Lines of an Inscribed Six-point of a Conic. By Professor R. D. Bohannan, Columbus, Ohio.

21. Stereoscopic Views of Spherical Catenaries and Gyroscopic Curves. By Professor A. G. Greenhill, Royal Artillery College, Woolwich.

No. 1 pointed out that to every simple isomorphism of a group to itself corresponds some substitution of its operators; and that to all such isomorphisms corresponds a substitution group, which has been called the *group of isomorphisms* of the given group. A new and simple proof was given of the following theorem of Jordan's: When a regular group (R) of order n is transformed into itself by the largest possible group (L) of its own degree, the subgroup of L which includes all its substitutions that do not contain a given element is the group of isomorphisms of R. Other theorems were proved regarding those isomorphisms which may be derived from a given one by means of real transforming operators.

In No. 2, of which a brief abstract was read by the Secretary, the general group is that of Lie's Kugelgeometrie. All infinity in space is regarded as a single point and all planes as spheres through the point at infinity. The general group is tenfold. All transformations leaving a point invariant form a sevenfold sub-group. There is a sixfold subgroup which leaves a sphere invariant, and which is identical with the sixfold group of circular transformations on the Neumann sphere or in the complex plane.

No. 3 was read in joint session of Sections A and B. It showed how to compute successive values of a function defined by a differential equation without solving the equation analytically. Using Newton's notation for derivatives of y as to x, and indicating successive values of y by subscripts, the simple trapezoidal rule would serve to express approximately the difference between $\dot{y}_0$ and $\dot{y}_1$ in terms of $\ddot{y}_0$ and $\ddot{y}_1$, and similarly that between y_0 and y_1 in terms of $\dot{y}_0$ and $\dot{y}_1$. Hence $\dot{y}_1$ and y_1 may be ultimately expressed in terms of y_0, $\dot{y}_0$, $\ddot{y}_0$, $\ddot{y}_1$. Substituting their values in the differential eqnation, the latter will give the value of $\ddot{y}_1$. This value substituted back will give values of $\dot{y}_1$ and y_1, and hence the quantities for the point 1 are completely

known when those for the zero point are assigned; and so on from point to point. The trapezoidal rule may be replaced by more accurate rules if desired. The method is applicable to equations of any order, and also to simultaneous equations.

No. 4 showed that if two matrices are commutative, *i. e.*, if $\varphi\psi = \psi\varphi$, then there is no latent system of any root of the one which lies in the extension composed of two or more latent regions of a root of the other unless it includes the entirety of these regions. The case when one of the matrices has equal roots was developed.

No. 5 presented a new theory of the quadratic equation $x^2 + 2bx + c = o$; stating that when b^2 is greater than c the roots may be either real numbers or 'hyperbolic complexes,' and that when b^2 is less than c the roots may be either 'circular complexes' or scalar numbers. In this view the square root of negative unity can in certain cases be interpreted as a scalar instead of a versor.

No. 6, which was read in joint session, showed by an example that when one term in the differential equation is the orthogonal projection of a plane motion, it is in some cases easier to pass to the auxiliary motion by means of 'planar algebra' than it is to proceed with the given equation directly. (See Trans. A. I. E. E., Vol. X., p. 186.)

In No. 7, of which the Secretary presented a brief abstract, there were $n - 1$ linear equations and one quadratic equation in the same n variables, and the problem was to determine when the simultaneous values of the variables that satisfy these equations are all real. The criterion obtained has applications for $n = 2, 3, 4$ or 5, whether the generating element be a point, a plane, a line or a sphere.

The object of No. 8, which was read by the Secretary, was to awaken an interest among astronomers and psychologists such as to induce them to pay more attention to the work of each other and thus improve their own methods where necessary.

In No. 9, which was presented in abstract by Dr. Shaw, the idea of obtaining the value of $A(m)$ the m^{th} compound of the determinant A, as a power of A by multiplying it by its adjugate $A(n - m)$, the $(n - m)^{\text{th}}$ compound of A, is extended to finding the value of certain minors of $A(m)$ in terms of A and its minors. By making use of a comprehensive notation the whole subject is unified, the laws of vanishing minors set forth, and such well-known theorems as Sylvester's and others are easily established.

In the absence of the author No. 10 was read by title, and a printed pamphlet was distributed in Sections A and B.

An abstract of No. 11 was presented by the Secretary. It stated that about 70 per cent. of the total magnetization of the earth can be referred to a homogeneous magnetization about a diameter inclined to the earth's rotation axis by an angular amount of about 12°. This axis has been termed by Gauss the earth's magnetic axis. It is an interesting question to determine the motion of this axis during the past two or three centuries, and Dr. Bauer's paper was an attempt to solve this problem as far as is possible with the data at present at command.

No. 12 was also read in brief abstract by the Secretary. It stated that as yet no formulæ had been found by which the diurnal range of the magnetic declination, for example, could be computed for various portions of the earth. The author has found the following simple formulæ to hold true within the fluctuations to which the quantities themselves are subject: Diurnal range of declination $= 2'.58 \sec^2 \varphi$; diurnal range of inclination $= 6'.1 \div 1 + 3 \sin^2 \varphi$; wherein φ, the magnetic latitude, is found from the equation $\tan \varphi = \frac{1}{2} \tan \mathrm{I}$, in which I is the magnetic dip. The first formula was discovered empirically, then under cer-

tain assumptions deduced theoretically. The second was then derived theoretically and was found to satisfy the data.

An abstract of No. 13 was read by the Secretary. It follows the theory of perturbations in the problems of mechanics in the order of its historical development from Lagrange to Lie with a view to the final presentation of the theory in its just position as one phase of Lie's theory of contact-transformations.

No. 14 was presented by the Secretary. It gave a bibliography of the Pythagorean proposition, followed by a general solution of the equation $x^2 + y^2 = z^2$, and concluded with an extensive numerical table of the sides of rational right-angled triangles.

No. 15 expressed in terms of the tabulated E and F functions a number of integrals, many of which had apparently never been completely worked out.

No. 16 showed how to express the effect of a small difference in the equatorial moments of inertia of the earth on the period of revolution of the instantaneous axis of rotation around the axis of figure. A remarkable value is obtained for the average angular velocity of that revolution, and a formula is deduced for the difference in the equatorial moments essential to explain the discrepancy between the observed and computed value of the Eulerian cycle.

No. 17 considered the case of no applied forces, or that in which there is conservation of moment of momentum. The problem is of practical interest in its application to the question of variation of latitudes on the earth. Several new theorems with respect to the motions of the mass were derived.

No. 18 obtained some general properties of a class of functions of which the spherical harmonics are special cases.

No. 19 described the present annoying state of the subject-matter of notation and coordinate systems, and advocated the adoption of certain standards. It is expected that this question will be further discussed at the Boston meeting with a view to obtaining a consensus on symbols and fundamental conventions.

No. 20 called attention to a certain quadrilateral whose properties throw new light on the theory of the Pascal lines of a hexagon inscribed in a conic.

In presenting No. 21 Professor Greenhill gave stereoscopic views of certain interesting curves in space and pointed out the bearing of some of them on certain parts of the theory of elliptic functions.

The section is also indebted to Professor Greenhill for interesting contributions to the discussions on many of the other papers.

The officers elected for the Boston meeting are Professors E. E. Barnard, of Yerkes Observatory, and Alexander Ziwet, of the University of Michigan.

JAMES MCMAHON.

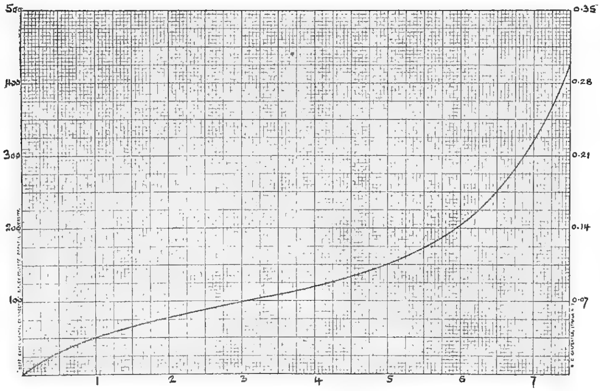
SINGULAR STRESS-STRAIN RELATIONS OF INDIA RUBBER.

THE curious and unaccountable behavior of India rubber in thermodynamic transformation of energy under load has long been familiar; it is, perhaps, even more generally known that it exhibits a peculiar relation of elongation to load when approaching its limit of tenacity, but I am not aware that this later phenomenon has ever been exhibited by formal test or by graphic representation of the results of such tests. It is a matter of common observation that, when this substance is subjected to a pull of steadily increasing intensity, its resistance increases as does that of any elastic and ductile material; but that, at the end, instead of suddenly losing power of resistance, or even snapping without observable decrease of load, its resistance for a time rapidly and largely increases up to the point

of rupture. This can be readily felt in even the breaking of one of the small bands of partially vulcanized rubber now so universally employed for filing papers and other purposes. At the end of the period of extension the resistance rises so rapidly as to produce the sensation of bringing the hand up against a rigid obstacle, resisting further elongation.

Figure 1 is the stress-strain diagram of a strip of rubber, partially vulcanized, but not sufficiently to disguise the peculiar characteristics of the material.

Studying this diagram, it will be observed that the substance behaves precisely like other familiar materials, up to a point which, in this case, is found at a load of thirty per cent. of the maximum, the breaking load, and at an extension one half the maximum. At this point there exists a reversal of the line, and the curvature is thence maintained convex to the axis of X, up to the point of rupture; fracture taking place, at the end, sharply and without any indication of that method of flow of the mass which, in the case of the irons and softer steels, for example, permits a falling-off of resistance after passing a point of maximum tenacity well within the breaking limit. The ratio of increase of load to increase of elongation steadily increases from the zero point, as with all substances, other than iron and steel, so far as known, up to this point of contrary flexure on the diagram; at which place the ratio is inverted and resistance increases in greater proportion than extension, finally assuming a comparatively high value.



Strain per Unit Length.

FIG. 1.—Stress-Strain Diagram of India Rubber.

The singularity of this action will be brought into relief by examining the diagrams produced with other materials employed in the arts.* Swedish or Norway Iron, Common Merchant Iron, 'Mild' Steel, and Tool-Steel have been subjected to loads increasing to the point of rupture, with occasional removal of the load.

*Thurston's Materials of Engineering, Vol. II., p. 611.

The nearly-vertical lines on each curve, at intervals, from the origin, are the 'elasticity lines,' as they have been called, showing the action of the material when the load is gradually relieved. These substances do not restore themselves to the original dimensions, but remain permanently distorted, taking more or less set and, usually at least, maintaining a constant value of the modulus of elascity. The slight droop in each line, near its outer extremity, shows the behavior of the substance when the load is left unchanged and elongation is maintained constant. This 'exaltation of the elastic limit' was discovered by me many years ago, and announced to the American Society of Civil Engineers in 1873.* India rubber exhibits none of the phenomena giving the characteristic form of the diagrams of the irons and steels. Even when stretched to the point of rupture it restores itself very nearly to its original dimensions and gradually recovers a part of the loss of form at that instant observable. Its almost complete stability of form when relieved from load, and especially when in the shape of springs such as are used on railway trucks, constitutes one of its most valuable properties. Like cork, when confined laterally, it is practically indestructible and incapable of distortion when used as a spring. The singular stress-strain relations of the substance may probably be found to give it peculiar value for many other purposes. The sample illustrated by our diagram was of the kind employed for springs and rubber bands and, as usual, slightly vulcanized.

The equation of the curve of this character described by the materials of construction generally may be taken, without important error, usually, as of the form

$$E=a\sqrt{T};$$

and with elongation, E, and T, tenacity, respectively, in per cent. of total length of specimen and in pounds per square-inch, the constant, a, is usually not far from 0.1 for good irons, 0.05 for tool-steels, and for good soft copper it is about 1.2. For this specimen of india rubber the equation is obviously so entirely different in class and form, and indicates so evidently an entirely different method of molecular action in resistance of strain, that it must constitute a problem by itself. The peculiarities of this form may, however, prove a key to the corresponding singularities of its internal structure and forces. So far as known, no other substance gives such unique relations of forces holding the substance in stable form to the variations of form to which the external application of force gives rise. The volume of the mass remains, so far as can be seen, constant, or nearly so, and the expenditure of work upon the substance results simply in changing the intermolecular distances of adjacent particles. This fact will probably be found to simplify the process of experimental interpretation of this curious case.

The cause of the singular behavior of this thermodynamically unique material remains to be discovered. It is probably safe to assume that its mechanical and physical properties will have some close relationship, and that the investigation, to be complete, must comprehend both lines of research. The gum must evidently possess either some very strange molecular force-relations or it must be the fact that, in the case of the ordinary materials of engineering and construction, these apparently peculiar characteristics are, in them, as yet unobserved because of their minute effects. The study of the subject cannot fail to lead to new and interesting facts relative to the molecular constitution of this and probably of other substances.

R. H. Thurston.

Cornell University.

* Trans. Am. Soc. C. E., November, 1873.

FIFTEENTH ANNUAL REPORT OF THE COMMITTEE ON INDEXING CHEMICAL LITERATURE.*

THE Committee on Indexing Chemical Literature presents to the Chemical Section its fifteenth annual report, covering the twelve months ending August, 1897.

WORKS PUBLISHED.

Recalculation of the Atomic Weights. By FRANK WIGGLESWORTH CLARKE. New edition revised and enlarged. Constants of Nature, Part V. Smithsonian Miscellaneous Collections, 1075. City of Washington. 1897. Pp. vi+370. 8vo.

Index to the Literature of the Periodic Law. In: 'Development of the Periodic Law.' By F. P. VENABLE. Easton, Pa. 1896. 12mo.

Partial Bibliography of Argon. By C. LE ROY PARKER. Accompanying his paper: 'Our Present Knowledge of Argon.' J. Am. Chem. Soc. xix+124 (February, 1897).

Bibliography of Agricultural Chemistry (American). Bulletins of the Office of Experiment Stations, United States Department of Agriculture.

In our fourteenth annual report the following correction should be made: *for* Bulletin No. 9 *read* Bulletin No. 19, *and add* Bulletin No. 27 (1897).

A card-index to Experiment Station Literature is issued by the Office of Experiment Stations; this is sent *gratis* to all the agricultural colleges and experiment stations in the United States, and is sold to a limited number of individuals and institutions. Eleven thousand cards had been distributed prior to September, 1896.

The detailed index included in each volume of the 'Experiment Station Record' contains numerous references to chemical articles published by the experiment stations in the United States and in foreign countries.

Abstracts of Chemical Work in Agricultural Science, published in: 'Experiment Station Record,' issued by the Office of Experiment Stations, United States Department of Agriculture.

These abstracts were begun in Vol. I., No. 1. (September, 1889). Abstracts of foreign investigations were added, beginning with Vol. II., No. 8 (March, 1891), and these have been included, with a quite rapid growth in the field covered, up to the present time. The work is in charge of Dr. E. W. Allen, who is assisted by Mr. W. H. Beal in the department of fertilizers and soils, and by the Committee on Abstracting of the Association of Official Agricultural Chemists.

The Review of American Chemical Research, edited by Professor Arthur A. Noyes, begun in April, 1895, and formerly published in the 'Technology Quarterly,' is continued in the 'Journal of the American Chemical Society.'

Periodicals Relating to Chemistry and Physics in the New York Public Library and Columbia University Library. Bulletin of the New York Public Library, Astor, Lenox and Tilden Foundations. Vol. I. No. 6. June, 1897. Page 152.

A very convenient check-list compiled with bibliographical accuracy, especially useful to students residing in New York and vicinity.

Bibliography of the Analysis of Chrome-iron Ore, Ferro-Chromium and Chrome-steel. By S. RIDEAL and S. ROSENBLUM. *Chem. News,* Vol. 73, p. 2. (January 3, 1897.)

A Bibliography of the Chemistry of Chlorophyll, by L. Marchlewski, accompanies his monograph: 'Die Chemie des Chlorophylls.' Hamburg and Leipzig. 1895. 8vo.

REPORTS OF PROGRESS.

A Bibliography of the Metals of the Platinum Group, 1748–1896, by Professor James Lewis Howe, has been completed, and after examination by your Committee has been recommended to the Smithsonian Institution for publication. The work is now going through the press.

A Review and Bibliography of Metallic Carbides, by Mr. J. A. Mathews, of Columbia University, was submitted to your Committee, and after examination by each member the MS. was returned to the author for minor improvements. The suggestions of the Committee were promptly accepted by Mr. Mathews, and the revised work has been recommended to the Smithsonian Institution for publication.

A Bibliography of Basic Slags, Technical, Analytical and Agricultural, has been completed by Karl T. McElroy, of the Division of Chemistry, U. S. Department of Agriculture. The channel of publication has not been determined.

*Presented at the Detroit meeting of the American Association for the Advancement of Science.

The second edition of the *Catalogue of Scientific and Technical Periodicals*, 1665–1895, by Dr. H. Carrington Bolton, is entirely printed, but publication is deferred, owing to the preparation of a new Library Check List, with which it will be accompanied. The new edition contains 8,603 titles.

CHEMISTRY.

A Supplement to the Select Bibliography of Chemistry, 1492–1896, has been completed by Dr. H. Carrington Bolton, who has presented the MS. to the Smithsonian Institution. This Supplement contains about 9,000 titles, including many chemical dissertations, and is brought down to the end of the year 1896.

Dr. C. H. Jouet reports his *Index to the Literature of Thorium* 'nearly finished.'

Dr. F. W. Traphagen reports 'fair progress' on his *Index to the Literature of Tantalum.*

Mr. George Wagner reports that he has made progress on the *Bibliography of Oxygen.*

Mr. H. E. Brown, under the direction of Professor A. B. Prescott, is preparing a *Bibliography of the Constitution of Morphine and related Alkaloids.*

Professor William Ripley Nichols, of the Massachusetts Institute of Technology, at the time of his death left an unfinished *Index to the Literature of Carbonic Oxid;* the manuscript was taken in hand by Professor Augustus A. Gill, of the same institution, who has done considerable work upon it; he now reports that he is not in a position to finish the task and he is perfectly willing to relinquish the large amount of material accumulated to anyone who would undertake to complete it.

Professor Clement W. Andrews, formerly of the Massachusetts Institute of Technology and now Librarian of the John Crerar Library, Chicago, reports that he is obliged to abandon work on his *Index to the Literature of Milk*, and will be very glad to turn over the material to anyone who cares to undertake to complete the bibliography.

It has always been the aim of the Committee on Indexing Chemical Literature to prevent duplication of work, but failure to inform the Committee of work in progress may defeat this undertaking. An announcement, in the Fourteenth Annual Report, of certain work having been nearly completed surprised a chemist in another part of the country, and has led to the abandonment by the latter of much laborious indexing.

In conclusion the Committee repeats the statement that it labors to encourage individual enterprise in chemical bibliography, and to record in the annual reports works issued and works in progress.

Address correspondence to the Chairman, at Cosmos Club, Washington, D. C.

H. Carrington Bolton, *Chairman*,
F. W. Clarke,
A. R. Leeds,
A. B. Prescott,
Alfred Tuckerman,
H. W. Wiley,
Committee.

CURRENT NOTES ON ANTHROPOLOGY.

THE STONE AGE OF PHŒNICIA.

The associations of Phœnicia with both sacred and profane history are so numerous that a careful investigation of its oldest human remains will attract general attention. Such an investigation is reported in *L'Anthropologie*, Nos. 3 and 4 of this year, by Professor Zumoffen, of Beyrut, Syria.

He gives a map of the prehistoric stations, and divides them into 'paleolithic' and 'neolithic,' according to the French canons of archæology. Of the former he describes six which he has explored. Two full-page plates present the objects in natural size. The most important finds were in a cavern in the valley of Antelias, which has also been visited by previous students (Fraas, Dawson).

Examined by the canons of American archæology, the claim for the vast antiquity of these remains is open to some doubts. Patination, which the author emphasizes, is dependent on soil and dampness more than age; one or more of the six stations he acknowledges were workshops, and the remains, therefore, are to be classed as 'rejects.' This explains the absence of pottery; but most significant is the fact (p. 426) that the fauna of the 'paleolithic'

and the 'neolithic' stations were the same, while the stratigraphic relations of the deposits are inconclusive.

ARCHÆOLOGICAL SURVEY OF OHIO.

IN a neat pamphlet of 110 pages, reprinted from Vol. V. of the Ohio State Archæological and Historical Society, Mr. Warren K. Moorehead, Curator of the Society, gives a readable report of the field-work carried on in the Muskingum, Scioto and Ohio valleys during the year 1896. The exhibit is most creditable to his energy and judgment. The aim of his investigation is to produce a reliable archæological map of the State, and also to examine critically some of the most remarkable ancient monuments and to collect the art remains of the former inhabitants. In all these directions he has been quite successful. Nearly seven thousand monuments of the indigenous tribes have been located and mapped. A limited number have been carefully excavated, and the total number of specimens obtained runs up into the tens of thousands.

The report is illustrated with forty-five figures in the text of noteworthy mounds or valuable specimens, and much collateral information relating to them is inserted. One prominent advantage has been the educational influence of the survey on the population. It is gratifying to learn (p. 261) that there are now in Ohio 310 persons interested in its archæology! Can any other State equal this record?

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

NOTES ON INORGANIC CHEMISTRY.

PROFESSOR MOISSAN and Professor Dewar publish in the *Comptes Rendus* further experiments on liquid fluorin. The boiling point is −187°; at −210° it still remains liquid, showing no sign of solidification. The density was determined by suspending in it several different substances which are unacted upon; amber was found to rise and fall in the liquid, hence its specific gravity was 1.14. No absorption bands were found by the spectroscope, and between the poles of a powerful electromagnet it showed no magnetic phenomena. Its capillarity is less than that of liquid oxygen and only one-sixth of that of water. At −210° it has no action on dry oxygen, water or mercury, but at this low temperature it still reacts violently with hydrogen, and even with the hydrogen in oil of turpentine. The explosive substance which in previous experiments they obtained when fluorin was led into liquid oxygen is not formed if oxygen is perfectly dry, and appears to be a hydrate of fluorin.

IN the *Pharmaceutische Zeitung* F. Sibbers, writing on the analysis of aluminum, claims that the proportion of silicon present is always underestimated, from the fact that when aluminum is dissolved in acid a con-considerable part of the silicon is evolved as hydrogen silicid and lost. The average amount of silicon usually found in aluminum is 0.3 %, but taking into consideration that which is lost in analysis the author considers that 0.6 % is usually present. As the presence of silicon is considered to be very detrimental to aluminum, these determinations of Sibbers deserve careful consideration.

DR. H. CARRINGTON BOLTON, whose Bibliographies of Chemistry and Scientific Periodicals have proved of so much value to chemists and other scientists, as well as to librarians, and who has done so much to throw light upon obscure points in the history of chemistry, has again put American chemists under obligation to him by a paper on 'Early American Chemical Societies,' which was recently read before the Washington Chemical Society, and now is reprinted from the *Journal* of the American Chemical Society. It appears that before

the end of the first quarter of the present century three chemical societies had been founded in this country, while the first chemical society of Europe, the Chemical Society of London, was not founded till 1841. Forty-nine years before this date, in 1792, the Chemical Society of Philadelphia was instituted. Its first President was Dr. James Hutchinson, and at his death he was succeeded by Dr. James Woodhouse, who was at that time professor of chemistry in the medical department of the University of Pennsylvania. Among the best-known members were Dr. Joseph Priestley and Robert Hare, the inventor of the oxy-hydrogen blowpipe. "The meeting of October 24, 1801, was made memorable by the appointment of a committee for the 'discovery of means by which a greater concentration of heat might be obtained for chemical purposes.'" On this committee was Robert Hare, then only twenty years old, and December 10th of the same year he reported, on behalf of the committee, his great invention. No memoirs were published by this Society, and how much longer it existed is a matter of conjecture. In August, 1811, the Columbian Chemical Society was founded, also at Philadelphia. It numbered sixty-nine 'Honorary' (regular) members, of whom thirty-one were Europeans, and thirteen 'Junior' (associate) members. Thomas Jefferson was patron; James Cutbush, President, and among the more distinguished members were Benjamin Smith Barton, Archibald Bruce, Joseph Cloud, Thomas Cooper, Robert Hare, James Madison, Benjamin Rush, Adam Seybert and Benjamin Silliman. The foreign members included the most distinguished chemists of England and France, and Proust of Madrid. No Germans were on the list, nor Berzelius. One volume of memoirs was published in 1813, now a very rare book. In his article Dr. Bolton gives interesting abstracts of the papers in this volume. September 6, 1821, there was founded at Delhi, New York, the Delaware Chemical and Geological Society, a local society of forty or fifty members, having 'for its object the improvement of the members in literature and science, especially in chemistry and mineralogy.' Considering "the limited facilities for acquiring chemical knowledge in the New World" (chiefly in the medical schools) "and the distance of amateurs from the European head-centers of learning, it is certainly noteworthy that American chemists combined to form associations for mutual improvement and the advancement of their calling at so early a period." The fourth chemical society in this country was the American Chemical Society, founded at New York in 1876, and broadened in its scope in 1892, until it now numbers 1,106 members, working in nine chartered sections, representing forty-seven States and Territories, and several countries of Europe, South America, and even Australia.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

We record, with deep regret, the death at Philadelphia, on November 14th, of Dr. Harrison Allen, emeritus professor of comparative anatomy in the University of Pennsylvania.

The American Psychological Association will meet at Ithaca, in conjunction with 'The Naturalists' and affiliated societies, on Tuesday, December 29th, and the two following days, under the presidency of Professor J. Mark Baldwin, of Princeton University. It is intended to place papers on experimental and physiological psychology on the first day and on the final day papers having closer relations with philosophy. On Wednesday morning there will be a discussion on 'The Psychology of Invention,' which it is expected will be opened by Professor Josiah Royce, Harvard University; Professor John Dewey, University of Chicago, and Professor Joseph Jastrow, University of Wisconsin.

A committee of the American Chemical So-

ciety appointed in 1893 issued a circular letter addressed to foreign chemical societies, with a view to organizing a series of international chemical congresses, similar to the International Congress of Chemists held in connection with the World's Columbian Exposition. This committee has been compelled to report through its chairman, Professor F. W. Clarke, that a few favorable replies were received from minor organizations, but not from any of the great chemical societies, and the committee asks to be discharged, leaving the initiative to other organizations.

DR. B. ENGELHART has given up his observatory at Dresden and presented the instruments and library to the University Observatory at Kasan.

DR. MARK OLIVET, professor of psychiatry in the University of Geneva, and the author of numerous publications on medicine and hygiene, died at Geneva on October 24th, in his seventy-sixth year.

A MONUMENT to Duchenne has been erected in the Saltpêtrière. Duchenne began at Bologne by treating nervous diseases with electricity, and after he went to Paris never held any university or hospital position, but to him we owe the first description of locomotor ataxy and many forms of muscular wasting, as well as important advances in the physiology of movement.

PROFESSOR VON KÖLLICKER, Würzburg, has been given the Anders Retzius medal by the Association of Swedish Physicians.

PROFESSOR VON RÖNTGEN, Würzburg, has been elected an honorary member of the Swiss Scientific Society, Berne.

IT is stated in *Nature* that Professor F. Omori, of the Seismological Institute, Tokio, is now in India, for the purpose of investigating the recent Calcutta earthquake and reporting on the same to the Japanese government.

DR. LEHMAN NIETSCHE has been appointed keeper of the anthropological department of the La Plata Museum, succeeding Dr. Ten Kate.

THE Appalachian Mountain Club of Boston gave a reception on Monday of this week, at which were exhibited Harvard Geographical Relief Models, new Sella Photographs and photographs of the mountains along the Great Northern Railway. On November 10th Professor William M. Davis addressed the Club on the Harvard Geographical Models.

DR. KAKICHI MITSUKURI, the eminent zoologist, professor in the University of Tokio and delegate from Japan to the recent conference on seal fisheries, lectured this week at Johns Hopkins University, of which he is a former student.

THE following courses of lectures on natural science are being given at the Philadelphia Academy of Natural Sciences under the Ludwick foundation. They are given at 4:30 in the afternoon and admission is free. The subjects are: 'Malacology,' Professor Henry A. Pilsbry, November 1st, 8th, 15th, 22d, 29th, December 6th; 'Geology,' Professor Angelo Heilprin, November 2d, 9th, 16th, 23d, 30th, December 7th; 'Invertebrate Zoology,' Dr. Benjamin Sharp, November 3d, 10th, 17th, 24th, December 1st, 8th; 'Vertebrate Zoology,' Witmer Stone, M.A., November 5th, 12th, 19th, 26th, December 3d, 10th; 'Hygiene and Sanitation,' Dr. Seneca Egbert, January 7th, 14th, 21st, 28th, February 4th, 11th; 'Botany,' Mr. Stewardson Brown, January 10th, 17th, 24th, 31st, February 7th, 14th; 'Entomology,' Professor Henry Skinner, January 12th, 19th, 26th, February 2d, 9th, 16th.

AT the meeting of the Botanical Club of the University of Chicago, on November 9th, the hour was devoted to a brief review of the life of the late Professor Julius von Sachs. Professor Coulter read a translation of a short history of Sachs' life prepared by his pupil, Dr. Fritz Noll, which will appear in the *Botanical Gazette*. Professor Loeb then gave some personal reminiscences of von Sachs.

COMPLETE plans for the Zoological Gardens in Bronx Park have been prepared by Heins & La Farge, the architects, and were laid before the Park Commissioners on Monday. There has not been much change from the present topography of the Park, which the architects and experts found admirably adapted for the purposes of the Zoological Gardens.

AT the last meeting of the Trustees of the New York Public Library, Mr. Andrew A. Green offered a resolution for the appointment of a com-

mittee to consider and report on the expediency of uniting all the public libraries in the city. Mr. Green, Mr. Lewis C. Ledyard and General Philip Schuyler were appointed members of the committee. The intention of this resolution is to put all the public libraries under one working head and management and systematize the work throughout the city, the New York Free Circulating Library being the library that the the Trustees especially desire to have united with the New York Public Library.

The corner stone of the new building for the Bellevue Medical College, replacing that destroyed by fire and necessary owing to the failure of the plan for consolidation with New York University, was laid on the afternoon of November 13th. Mr. D. Ogden Mills, President of the Board of Trustees, made an address, and addresses were made in the Carnegie Laboratory by the Rev. Roderick Terry, of the Board of Trustees; Dr. Langdon Gray, representing the Alumni, and Dr. John S. Billings, for the medical profession. The new building, which occupies a plot of ground 75 x 100 feet, will be of granite and brick, five stories in height, and is expected to be ready in the spring.

At the inaugural meeting of the Röntgen Society, to which we referred last week, after the address by Professor Silvanus P. Thompson, there was an exhibition of apparatus and photographs. In its account the *Times* mentions only two exhibits, both from America: "In the hall a splendid assortment of photographs was exhibited, perhaps the most striking being a life-sized skiagram of the entire skeleton of a full-grown living woman, taken by Dr. W. J. Morton, of New York. Apparatus for the production of Röntgen rays was also on view, the chief novelty being an electric oscillator, made and specially sent by Mr. Tesla, in the construction of which no thin wire is employed. When one of Tesla's own tubes is excited with this machine the emission of Röntgen rays is so intense that, standing 50 feet away from it, one can still obtain on a luminescent screen the shadow of the bones of one's hands."

We learn from the *Botanical Gazette* that Dr. J. M. Rose returned from his Mexican trip early in October. His work was chiefly confined in the little-known parts of the Sierra Madre. He visited Guaymas, La Paz (L. C.), Mazatlan and Acaporeta, on the western side, crossed the two ranges of the Sierra Madre north of the Acaporeta and made two excursions into them, one from the west at Rosario, and the other from the east at Bolanos, the latter being one of Seeman's stations. The States chiefly explored were Durango, Jalisco, Zacatecas and the Territory of Tepic. The collection contained 2,000 numbers, and is especially rich in umbellifers, agaves and orchids, many living specimens of the two latter groups having been shipped for cultivation.

Mr. A. P. Morse, curator of the zoological museum of Wellesley College, has returned from a collecting expedition to the Pacific coast, planned under the direction of Mr. S. H. Scudder. He has brought back large collections, especially of orthoptera, for class work and for the museum.

A cablegram from Stockholm states that King Oscar and a number of private persons have contributed sufficient sums of money to insure the despatch of a Swedish Polar expedition in 1898, which will be led by Professor Nathorst, the geologist. The cost of the expedition is estimated at 70,000 crowns.

The seals caught at sea during the present season are said to be fewer than last year. The figures reported are as follows: Total catch of seals in the north Pacific for the present season, 38,700 against 73,000 last year. The catch in Bering Sea, which is that portion of the north Pacific in which the United States is interested, is 16,650 for the present season, against 29,500 last season, a reduction of about one-half. Of the catch in Bering Sea, British vessels took 15,600, American vessels 1,050.

Mr. H. C. Mercer and Professor H. C. Warren have retired from the board of associate editors of the *American Naturalist*. We understand that hereafter anthropology and psychology will not be included in the scope of the journal.

The *Asa Gray Bulletin*, edited by Mr. J. H. Hicks, is now being published at Washington as a bi-monthly magazine for popular botany.

Beginning with next year, a journal, enti-

tled *Archives de Parasitologie*, edited by Professor Raphael Blanchard, will be published at Paris.

THE current number of Virchow's *Archiv* is the 150th and is published fifty years after the establishment of the *Archiv*, in 1847. It contains a portrait of Virchow and two articles added to the long series contributed by him since he published seven in the first volume, fifty years ago.

THE *Open Court* for the present month has as a frontispiece a portrait of Euler and publishes some biographical notes on the great mathematician. Portraits of other mathematicians will be given in other numbers of the journal.

MESSRS. HOUGHTON, MIFFLIN & CO. have published for the Appalachian Mountain Club, of Boston, a guide book to the region about the city, prepared by Mr. Edwin M. Bacon. It contains 410 pages, with four folding maps and 150 illustrations. The opening chapter quotes President Eliot's characterization of the country round about Boston as the most interesting historical region in the United States, and one of the most beautiful he had ever seen here or in Europe; and his advice to the students is 'to learn the whole region by heart.' For this purpose the book, which pays special attention to the natural history of the region, will be a most useful guide.

IN a recent paper, published in the Transactions of the Edinburgh Field Naturalists' and Microscopical Society, Mr. Symington Grieve brings the history of the Great Auk down to July 31st of this year, noting the new specimens of eggs which have come to light within the past few years as well as the changes that have taken place in the ownership of specimens. It appears that the highest price paid for an egg was 300 guineas by Sir Vauncey H. Crewe, while Mr. Rowland Ward gave 600 guineas for a skin and egg. The article is accompanied by five plates of mounted specimens, three of which are of special interest from the fact that they are from young individuals.

ACCORDING to the *Botanical Gazette* the two important collections left by the late Dr. Edmund Russow, of the University of Dorpat, are to be sold. One is a collection of about 3,750 fully prepared and well preserved microscopical preparations, including the original mounts used for the late owner's classical investigations. The second collection is the Sphagnum collection, of which group Russow was known as one of the foremost students. It consists of 314 fascicles and about 3,000–4,000 microscopical preparations, with outline sketches of the same, especially of the species that have been already worked up. There are, in addition, 300 photographic lantern slides of localities of the different sphagnums. Further information regarding the collections may be obtained from Frau Professor Emma Russow, Schloss Str., 15, Dorpat, Russia.

REUTER'S agency reports that at the headquarters of the Russian Imperial Geographical Society, on the 27th inst., M. Sven Hedin, the celebrated Swedish traveler, delivered an address before a large and brilliant audience upon his recent journey across the Pamirs, Kashgaria and the Lob Nor. He started at the beginning of 1894 for the Pamir military post in Kashgaria, and ascended and mapped the glaciers of Mustagh Ata (20,000 feet). During the autumn he proceeded in the direction of Lake Teschil-Kul to explore it, and also the Alid-Schur Mountain range. He returned to Kashgar to pass the winter, and spent the time in arranging the scientific material which he had collected. In February, 1895, M. Sven Hedin set out to cross the Takla Makhan desert, but was compelled to return to Kashgar. In December, 1895, he went by way of Khotan towards Lake Lob Nor, traversing a desert 300 km. wide. During this journey which occupied four months and a half, M. Sven Hedin discovered the remains of two ancient towns and the ruins of Buddhist monuments. Proceeding as far as the Kiria Daria river he ascertained that this stream ran as far as 39° 30′ N. He found in that region a tribe of half-savage shepherds, unknown even to the Chinese. Pushing on to the Chinese town of Koreia, along the banks of the river Tarim, M. Sven Hedin reached the Chinese, or northern, part of Lake Lob Nor. From LobNor, in the spring of 1896, he came back to Kholan, and then returned to Kipa, in order to undertake a journey in north-

ern Tibet and on the heights in that region. During this expedition the explorer discovered a lofty mountain range, whose highest peak rose about 24,000 feet above sea level. This was named Mount Oscar. He also found in this region twenty-three salt-water lakes. M. Sven Hedin then proceeded *via* Tsaidam, Kuku Nor, Si-ning-fu, Liang-chu, the deserts of Alashan and Ordos to Peking, which city he reached on March 14, 1897, across northern China. The expedition, the cost of which was defrayed by the King of Sweden, M. Nobel and several other rich Swedish gentlemen, was the means of securing botanical, geological and archæological collections, notably several ancient Buddhist MSS., found at Khotan, and about 500 sheets of topographical plans, as well as a large number of photographs.

THE lecture at the annual public meeting of the five Paris Academies was given by M. Moissan, who chose as his subject 'The University of Chicago,' and made use of impressions obtained on his recent visit to America. The address, published in the last number of the *Revue Scientifique*, may be read with profit and amusement. After an introductory paragraph M. Moissan begins: "Il y avait une fois, à l'Université de Yale, près New-Haven, un professeur de langues hébraïques nommé Harper. Cet homme, qui avait beaucoup voyagé et qui connaissait bien les établissements d'instruction de son pays, avait la prétention de fonder la plus grande université des Etats-Unis. Sans cesse il poursuivait cette pensée, s'enfermant en elle et lui donnant le meilleur de son intelligence. Son idée devint une idée fixe, et ce qu'il y avait de plus grave, c'est qu'il raisonnait parfaitement son cas. Il prétendait, ce professeur d'hébreu, qu'une université vraiment digne de ce nom devait présenter certaines qualités particulières. Il voulait, par exemple, la séparation complète de l'enseignement supérieur et de l'enseignement secondaire, ce qui ne se fait pas souvent aux Etats-Unis."

THIS year's experience with yellow fever in the South, which has cost the country more than sixty million dollars, says the Boston *Transcript*, has led to a movement among medical and scientific men to have the disease studied more thoroughly than heretofore and, if it is possible, to control it as they have other infectious and contagious diseases. A committee of seven, which was appointed by the American Public Health Association at the annual meeting in Philadelphia a short time ago, has waited upon President McKinley and laid before him the urgent necessity, as viewed by the Association, for the appointment by Congress of a commission of expert bacteriologists to be sent to Havana for the purpose of making a thorough study of the cause and prevention of yellow fever. This committee consists of Dr. H. B. Horlbeck, Charleston, S. C.; Dr. Samuel H. Durgin, of Boston; Dr. A. H. Doty, of New York; Dr. G. M. Sternberg, U. S. A.; Josiah Hartzwell, Canton, O:; Dr. S. R. Olliphant, New Orleans, La., and Dr. R. M. Swearingen, Austin, Tex.

THE last number of the *Journal of Comparative Neurology* contains the text of four 'Lectures on the Sympathetic Nervous System,' given before the medical students of the University of Michigan in May, 1897, by Dr. G. C. Huber. The newer literature is critically reviewed in the light of the author's own researches, which are also quite fully outlined, and especial attention is devoted to the problem of the relation of the neurons in the sympathetic system. The original figures illustrate the sympathetic endings on striated and non-striated muscle cells, cardiac muscular cells, blood vessels, gland cells, epithelium of the bladder and the cells and pericellular baskets of the sympathetic ganglia of various vertebrates, together with diagrams in colors of the course and distribution of several systems of sympathetic neurons.

THE report of the Engineer-in-Chief of the United States Navy, just issued, includes the statement of the year's work in testing materials for machinery by Chief Engineer E. R. Freeman, who has had charge since the late change of policy, which permitted the assignment of work to engineer officers which had previously often been largely performed by inexpert officers of other departments. The supervising inspector reports that the present system of conducting the inspection of steel has thus

far proved very satisfactory, and has a very decided advantage over the former system in the point of time required to establish understandings between the manufacturers and the Bureau. There are many questions arising in the inspection of steel which can be decided or answered only by reference to the Bureau's plans and specifications, and which now come direct to the Bureau; whereas under the former system of inspection they came through the Steel Inspection Board, and the information desired in connection with them was, of course, returned to that Board for its decision, thus causing much delay. The inspection of steel and the designing of machinery made of that material being now under one head, the plans and specifications for that machinery and the specifications for that steel can be better adapted to the full capabilities of the steel maker, and will not be apt to ask of him anything beyond his capabilites.

THE visitation of Algeria by locusts last year is described in the last report of the British Consul-General, which is quoted in the London *Times*. It seems that Algeria was visited twice during the year, the first flight appearing in the winter as far north as the Mediterranean coast, and a second one, which was normal, in the spring and early summer. There is no record of any flight such as the early one in the history of Algeria, and as they appeared so early it was believed they were sterile; but the females began to lay in the usual way, only several months too soon. But in place of being hatched out in the usual period, they took more than twice as long, which seems to be something wholly new and unexpected in the life history of locusts. The appearance of the insect so far north as the Mediterranean in mid-winter is believed to be due to the drought which in the previous year devastated the southern districts and the Morocco Sahara. There being no vegetation in the Sahara, the locusts were forced to leave the grounds where they spend the winter, and, without making the usual halts, to hurry forward to places where food was obtainable. Up to this it was believed that the *maximum* period for the incubation of the eggs was 45 days; but it has been shown now that it extends in some cases to 70 days, so that the period may vary, according to the time of the year, from 15 days to 70. This unexpected visitation was met by exceptional exertions on the part of the government, the local authorities and trade committees. Oran, the province adjoining Morocco, was the only one invaded. The area over which the eggs were laid is estimated at 424,500 acres, and 270,120 bushels of young locusts were destroyed. The barriers, or lines of defence, made of the Cyprus apparatus, or of zinc, extended over 322 miles, while 27,113 ditches were dug at the foot of these to catch the young locusts. These figures do not take into account the work done by the administration of forests. The number of days' work furnished by natives during the campaign was 90,033. The efforts of the defenders were devoted mainly to saving the crops which were most valuable, such as the vines, and are said to have been very successful.

THE London County Council has adopted the following resolution: "That it be referred to the Parks Committee and to the Technical Education Board to consider and report as to the practicability of laying out plots of ground in certain parks in such manner as will afford assistance to scholars of elementary and secondary schools in the study of practical botany."

UNIVERSITY AND EDUCATIONAL NEWS.

THE report of the Treasurer of Yale University states that the additions to the funds of the institution during the past year amounted to $450,055, largely from the Fayerweather legacy. During the past ten years the funds of the University have been about doubled.

THIRTY scholarships have been established in the department of philosophy in the University of Pennsylvania, ten of which will be available this year, twenty next, and the whole number the following year.

PLANS have been adopted for the new Wilder physical laboratory at Dartmouth College. The building will be of brick, three stories high, 107 feet long by 56 deep, with a wing in the rear. It will front on College street, between the Richardson Hall and the Medical College. The building will provide lecture rooms and

laboratories for chemistry, physics and astronomy.

A movement has been started at Raleigh, N. C., for the establishment by the State of a textile school. A committee has been appointed to correspond with all mill-owners, newspapers and Legislators. In the Georgia Legislature a bill is pending for the appropriation of $10,000 for the establishment of a textile school.

On the recommendation of the governing board of the Sheffield Scientific School of Yale University, it has been decided to establish the degree of Master of Science, to be conferred on graduates of two years' standing or upwards, who have taken a first degree in science and who pursue successfully a higher course of study in science under the direction of the governing board.

Dr Lafayette B. Mendel has been promoted to an assistant professorship of physiological chemistry in Yale University.

Dr. George T. Kemp has been appointed professor of physiology in the University of Illinois.

The director o Sibley College, Cornell University, has been authorized to establish a full professorship of railway machine design and locomotive construction. At present this work is carried on in existing departments.

Professor Oscar Loew, who has been for four years professor of agricultural chemistry in the University of Tokio, has returned to Munich. He will be succeeded by Dr. Bieler, now assistant in the laboratory of agricultural chemistry at Halle.

A croom Robertson fellowship with an endowment of £8,000 has been created in the University of Aberdeen, with which Robertson was connected before being called to the Grote chair of philosophy of mind and logic in University College, London.

A chair of geography has been established in the University of Würzburg.

The Technical Institute in Munich has been given by the government 175,000 Marks for enlarging the electro-technical laboratory, 150,000 Marks for the erection of a laboratory for the agricultural station and 170,000 Marks for enlarging other buildings.

The newly established medical school for women in St. Petersburg opens with 165 students.

The Russian government has appropriated 400,000 roubles for the construction of a chemical laboratory at the Polytechnic Institute at Riga.

DISCUSSION AND CORRESPONDENCE.

DETERMINATE VARIATION AND ORGANIC SELECTION.

A few remarks may be allowed on the subject discussed in the reports of the papers of Professors Osborn and Poulton, on 'Organic Selection' in the issue of October 15th. I venture to make these comments now, although the more extended publication of the articles of the authors may remove my *causas scribendi.* Yet such preliminary reports have their main utility, to my mind, in arousing comments which may be of service to the authors.

I may throw my remarks into heads for the sake of clearness.

1. Professor Osborn's use of the phrase 'determinate variation' I find ambiguous, and the ambiguity is the more serious since it seems to me to prejudice the main contention involved in the advocacy of 'Organic Selection.' The ambiguity is this: He seems to use *determinate variation* as synonymous with *determinate evolution.* (See his discussion, Science, Oct. 15, pp. 583–4, especially p. 584, column 1, and paragraph 2 of column 2.) He says that *determinate variation* is generally accepted, and attributes that view to Professor Lloyd Morgan and myself. But it is only *determinate evolution* that I, for my part, am able to subscribe to; and I think the same is true of Professor Morgan.

'Determinate evolution' means a consistent and uniform direction of progress in evolution, *however that progress may be secured, and whatever the causes and processes at work.* Admitting 'determinate evolution,' the question, therefore, as to the causes which 'determine' the evolution is still open, and various answers have been given to it. The Neo-Lamarckians say

'use-inheritance' (as Eimer, who calls the determination secured by this means *Orthogenesis*); Weismann says, 'germinal selection; I have suggested 'Organic Selection' (the resulting determination of evolution being called by me 'Orthoplasy'); others say, 'determinate variation' (continued in the same direction for successive generations); Professor Osborn says, 'determinate variation' with 'organic selection.' *Determinate variation*, then, in the proper meaning of that term, is only *one way of accounting for determinate evolution;* and to my mind, it is not the true way; at any rate it is not at all involved in the theory of 'organic selection' as I have advocated it.

Let us look more closely at 'determinate variation.' Supposing that by variation we mean 'congenital variation,' then we may ask: When are variations determinate? When for any reason they are distributed about a mean different from that required by the law of probability or chance. The problem of determinate variations is purely one of *distribution*; and is to be investigated for each generation, quite apart from its holding for a number of successive generations (and so giving 'determinate evolution').

Further, the possible determinateness of variation is to be distinguished carefully from the *extent* or *width* of variation. By 'extent' of variation is meant the limits of distribution of cases about their own mean; while relative determinateness means the distribution of cases about a mean established in the earlier generation. The question of determinate variation is: *Has any influence worked to make the mean of variation of the new generation different from that which should be expected from the characters of their parents,* * *whatever the extent of variation.*

*I expressly avoid saying what this mean is, *i. e.*, what the contribution of each parent is to the average individual of their offspring; but the work of Galton goes far to establish it. Much more investigation is needed on this point of making out what is indeterminate variation; how insecure, therefore, the claim that variations are determinate! The drift of recent statistical studies goes, however (as far as I am familiar with them), directly to show that in their distribution—considered apart from their extent— variations follow the probability curve.

2. As I have said in a recent article * the assumption of the paleontologists (Osborn, *loc. cit.*, pp. 584–5) that because certain fossils show determinate progress—*determinate evolution*, therefore there must have been *determinate variation*, seems to me defective logic. It is one possibility among others, certainly, but only one. And as I held in the same article, instead of being necessary as a support for organic selection, the latter comes as a new resource to diminish the probability that the variations have really been determinate in these cases. They may be cases of orthoplasy involving organic selection working as an aid to natural selection upon 'coincident' variations which are yet not determinate but fortuitous in the strict sense.

3. Without going into the question, I may yet point out that the position taken by Professer Poulton in the matter of the relation of natural to organic selection is, as he says, that advocated by me (with some of the same arguments); but it may be recalled that I gave natural selection still further emphasis by making the 'functional selection from overproduced movements,' whereby motor accommodations are secured, itself a case of natural selection broadly understood. I have recently drawn up a table showing the various sorts of 'selection' under the distinction of 'means' and (immediate) 'result,' finding some twelve sorts of selection. I venture to reprint this table here, with the remarks which accompany it in my book on 'Social and Ethical Interpretations in Mental Development' (Macmillan, 1897), hoping that it may be discussed. The terms in the table which relate to social evolution are fully explained in the book; they are not so essential to the topic now before us.

The table and the remarks upon it (*loc. cit.*, Appendix B), slightly revised, are as follows:

"The various sorts of 'Selection' which it seems well to distinguish in different connections may be thrown together in the following table, the corresponding sections of the book (as far as there are such sections) being in each case given in brackets in the table beside the description:

* *The Psychological Review*, July, 1897, p. 397.

SELECTION.*

SORT.	MEANS.	RESULT.
1, 2. Natural Selection { I. Darwin, Wallace, Spencer) [40]. II. (Eimer) [40].	1. Struggle for Existence (Darwin, Wallace). 2. Inherent Weakness, without Struggle.	1. 'Survival of the Fittest' Individuals (Spencer). 2. Destruction of Unfit Individuals.
3. Germinal Selection (Weismann).	3. Struggle of Germinal Elements.	3. Survival of Fittest Germinal Elements.
4. Intra-Selection (Roux, Weismann, Delage).	4. Struggle of Parts (Roux).	4. Survival of Fittest Organs.
5. Functional Selection (Baldwin).	5. Overproduction of Movements (Bain, Spencer, Baldwin).	5. Survival of Fittest Functions.
6. Organic Selection (Baldwin, Osborn, Lloyd Morgan) [Appendix A].	6. Accommodation (Baldwin); Individual Adaptation (Osborn); Modification (Lloyd Morgan).	6. Survival of Accommodating Individuals.
7. Artificial Selection (Darwin).	7. Choice for Planting and for Mating together.	7. Reproduction of Desirable Individuals.
8. Personal Selection† [40].	8. Choice.	8. Employment and Survival of Socially Available Individuals.
9. Sexual Selection (Darwin) [40].	9. Conscious Selection by Courting, etc.	9. Reproduction of Attractive Individuals.
10. Social Selection† [40, 120].	10. Social Competition of Individuals and Groups with Natural Selection (Malthus, Darwin).	10. Survival of Socially Fittest Individuals and Groups.
11. Social Suppression† [38 ff].	11. Suppression of Socially Unfittest (by Law, Custom, etc.).	11. Survival of Socially Fit.
12. { Imitative Selection† [40, 121, 307]. Social Generalization† [121, 310 ff]	12. Imitative Propagation from mind to mind with Social Heredity.	12. Survival of Ideas in Society.

"Certain remarks may be added, to which I give numbers corresponding to those topics in the table to which they respectively relate:

"4, 5, 6. By a singular coincidence M. Delage uses the phrase 'Selection organique' (*Struct. du Protoplasma*, etc., p. 732)to describe Roux's 'Struggle of the Parts.' Seeing that Weismann's 'Intra-Selection (4) was directly applied by him to his interpretation of Roux's 'Struggle,' Delage's phrase is not likely to have currency as a substitute for Intra-Selection. As 'Functional Selection' (5) is a special means of motor accommodation, it is additional, and in a sense subordinate, to Intra-Selection, since it has a *functional* reference.

"7, 8, 9. I do not give a separate heading to Professor Lloyd Morgan's phrase 'Conscious Selection,' since it will be seen that, as he uses it, *i. e.*, in broad antithesis to 'Natural Selection,' it really includes all those special forms of selection in which *a state of consciousness plays the selecting role** (7, 8, 9, 11, 12); it may become ambiguous in reference to cases where *natural selection operates on mental and social variations* (5, 6, 10); and even when applicable, as in 'Sexual Selection' (9),† with respect to the 'means' of the selection, it is still ambiguous with respect to the 'results' of the selection. This last ambiguity, which is brought out in the table (8, 9),‡ makes it desirable to confine the phrase 'Conscious Selection' (if used at all) to cases which result in continuance of what is de-

*I am indebted to Professor Lloyd Morgan for several suggestions utilized in the Table.

† Suggested in this work.

*This, indeed, is still liable to the question as to *whose is the state of consciousness*, giving the difference (both in means and result) seen between 'Artificial' (7) and 'Sexual' (9) selection. It is strange that Professor Morgan makes no allusion (?) to Romanes' earlier suggested term 'Psychological Selection.'

† Lloyd Morgan, *Habit and Instinct*, pp. 219, 271.

‡ The bird 'selects' (sexually) for the sake of the experience, and it is a secondary result that she is also thus 'selected' for mating with the male and so for continuing his attractive characters with her own characters in the offspring.

sirable for consciousness or thought. I have suggested 'Personal Selection (8) for the selection *of* individual persons *by* personal choice, analogous to 'Sexual Selection' (9) in the animal world. Furthermore, Darwin's 'Artificial Selection' should be used, as he used it, with reference only to securing results by induced mating.

"10, 11, 12. In all sorts of so-called 'selection,' *considered as factors in progress from generation to generation, in which the laws of natural selection and physical reproduction do not operate together*, I think it is extremely desirable that we discard the word 'selection' *in toto*, and give to each case a name which shall apply to it alone. The cases of the preservation of individuals and groups by reason of their social endowments do illustrate natural selection with physical reproduction, so I propose 'Social Selection' (10) for that. But in the instances in which either physical heredity is not operative (12), or in which it is not the only means of transmission (11), we cannot secure clearness without new terms; for these two cases I have suggested 'Social Suppression' (11), and 'Social Generalization' (12). The phrase 'Imitative Selection' is given in the table alternately for the latter (12), seeing that the discussions of the topic usually employ the term 'Selection' and use (wrongly) the 'Natural Selection' analogy. Selection may be used also when there is no reference to race-progress (and so no danger of the misuse of the biological analogy); since it then means presumably the 'conscious choice' of psychology and of pre-Darwinian theory."* J. MARK BALDWIN.

PRINCETON, October 20, 1897.

* It may be well to add that this table is not intended to be altogether exhaustive from the biological standpoint. For example, Professor Minot's 'Post-Selection' and Romanes' 'Physiological Selection' do not fall readily into the scheme. Nor are the different headings in all cases exclusive of one another, *e.g.*, Darwin really included both the cases (I. and II.) of Natural Selection under the single phrase; and justly so, seeing that they illustrate a single principle.

AMPHIBIA VS. BATRACHIA.

I HAVE been much interested in reading the communications of Dr. Gill and Dr. Baur on the above subject, and having developed certain convictions thereon I beg leave to state them. Before proceeding to do this I wish to express my appreciation of the reasonableness of the condition of doubt in which Dr. Wilder finds himself.

Formerly I employed the term *Batrachia*. Later I became inclined to regard *Amphibia* as having superior claims, principally because it has been used and insisted on by many careful writers. I trust that my present views rest upon a better foundation.

In Dr. Baur's communication of July 20th his conclusion is summed up in the following words:

"Three years later Latreille used the Latin names *Reptilia* and *Amphibia* for de Blainville's classes *Reptiles* and *Amphibiens*, and these names ought to be used."

However, it appears to me that he has failed to tell us why they ought to be used; that is, he has not stated the principles which make it obligatory on us to use them. He has only given us an excellent history of the case and his conclusion. We have definite laws governing the formation and use of generic and specific names, but the only law cited by Dr. Baur which applies to appellatives of higher rank is that which deprives of binding authority all vernacular names, even though they may seem to imply the Latin forms. This rule, which most naturalists will endorse, materially clears the ground in the present case. Chéloniens, Ophidiens, Batraciens, and Amphibiens stand on the same footing as Schildkröten, Schlangen, Toads, and Turtles.

It might be supposed that Dr. Baur relies on the law of priority to sustain him, since he is so careful, and properly so, to give the dates of proposal of each of the names employed; but the fact that he rejects *Ranæ* as a name for the frogs, etc., makes it evident that he demands something more. Dr. Gill says that we must be guided by the law of priority in the selection of names.

One thing is very certain, and that is that we cannot rigidly enforce, with respect to the appellatives of higher rank, the same rules that apply to genera. Common usage must and does determine much in the case of the former terms. The law of priority and a desire to

preserve Linnæus' names would probably impel us to overthrow the usurping title *Elasmobranchii* in favor of Linnæus' quite appropriate word *Nantes*. Linnæus' apt *Testacea* has been crowded out of all authority by the upstart *Mollusca*, which, originally ruling over a petty section of heterogeneous elements, now stands at the head of a vast sub-kingdom. Linnæus' beautiful name *Zoophytes* is now replaced by *Cœlenterata*, suggestive of famine. The strict law of priority applied to the term *Reptilia* would result in restricting it to ordinal rank or in worse consequences. Laurenti, 1768, employed it to include Linnæus' *Amphibia* minus the *Nantes*. It then either became a synonym of *Amphibia* or restricted the latter term to the *Nantes*. But the man who at this day attempts to oust *Reptilia* from its position in nomenclature will shed his ink in vain. Furthermore, the contest for the headship of the class embracing the frogs and salamanders lies between *Amphibia* and *Batrachia*. No *Ranæ*, *Ichthyoidea* or *Nudipellifera* need apply.

A word now regarding the use of the word *Amphibia*. Linnæus and some of his disciples included under it not only the reptiles and batrachians, but also various fishes. These being at length excluded, the term was employed for nearly a hundred years by various writers of standing to embrace all the reptiles and ranine and salamandrine forms. In 1825 it seems to have been used for the first time by Latreille, to designate what are now commonly called the batrachians, or amphibians. This is the date given by Dr. Baur, and is most probably the correct one.

In 1804 Latreille recognized the fact that the frogs and salamanders form a natural group, and he called this group the order *Batrachii*. We can hardly suppose that this name will be rejected because of its masculine ending. But if so, the honor of giving the name to the group belongs to Gravenhorst, who in 1807 called it *Batrachia*. But the advocates of *Amphibia* reject Gravenhorst's name, because it was used for the group as an order. Then, must every group be rechristened whenever its rank is changed? I know of no rule of nomenclature requiring this, nor does common usage demand it. Most ichthyologists regard the *Elasmobranchii* as a subclass of *Pisces*. Must those who consider it a distinct class seek a new name? Whenever the word *Mollusca* was applied to the group of mollusks the name dated from that time, even though the group may still have been looked upon as an order of *Vermes*. In the words of Professor Cope (Batrachians N. A., p. 20), 'the rank assigned to such division is immaterial; the idea of the division itself is everything.'

But even in case it were necessary to estimate correctly the value of a group when its name is applied to it, the term *Batrachia* may yet succeed in running the gauntlet. In 1820 Merrem recognized in Linnæus' *Amphibia*, minus the *Nantes*, *two distinct classes*. These he named and adequately defined. The one, *Pholidota*, corresponds to our *Reptilia;* the other he called the *Batrachia*, and it corresponds with the group now so-called. What rule or practice of nomenclature was not complied with by Merrem in this case? This was five years before Latreille restricted the title *Amphibia* to the same class.

If I correctly understand Dr. Baur, he rejects Merrem's name because the latter writer still considered his classes as holding such a relation to each other that they might be brought under the name *Amphibia*, regarded, perhaps, somewhat in the sense of a super-class. Is there any law against this? Such a law would have to be formulated somewhat thus: A class name to be acceptable must originally have been applied to the group regarded as a class, and the author must have entertained opinions now held as orthodox regarding the relationships of his class to other classes.

In conclusion, I will say that, from the evidence now in, it appears to be a very plain case in favor of the defendant, *Batrachia*. I should say that it dates, as a name, from Latrielle, 1804, or from Gravenhorst, 1807; most certainly not later than Merrem, 1820. *Amphibia* has been employed in so many senses that it leads to confusion. It should be reserved for those who may now or hereafter hold there is some special relation between the reptiles and batrachians.

I am sorry to differ with my friends, Dr. Gill and Dr. Baur.

O. P. Hay.

U. S. National Museum, September 24, 1897.

THE BRITISH AND AMERICAN ASSOCIATIONS.

TO THE EDITOR OF SCIENCE: Those members of the American Association for the Advancement of Science who went from Detroit to Toronto naturally made comparisons as to the methods by which the affairs of the two organizations were conducted. Permit me, therefore, as one who attended both meetings, to suggest three things which, if properly carried out, will tend to improve, at least to a certain extent, some features in the American Association.

First. The addresses of the President and Vice-Presidents of sections should be in type and ready for publication at the time of the meeting of the Association. By this means the addresses would be available to the daily and scientific press, and every address would be given out at the same time. At Detroit the President's address was not properly reported by any local newspaper, and of the Vice-Presidential addresses only that of Professor Mason was available in pamphlet form.

Second. All papers passed by the sectional committee should go through the hands of a competent press secretary, specially hired for the purpose, preferably a scientific man, who should prepare suitable abstracts of the same for publication. These abstracts should be duplicated by some convenient copying process and given to reporters as desired.

By the combination of these two methods a proper and dignified presentation of the work of the Association would be given to the public, and by using the same for the proceedings the publication of the volume could be begun at once at the close of the meeting. For with the addresses in type and the abstracts in manuscript the volume could be put together and issued as soon as it could be printed.

Third. In lieu of the single public reception given on the first evening of the meeting I would advocate a greater number of social functions at which the members could meet each other. At each meeting of the British Association, besides a reception, there is always a conversazione and a subscription dinner which is given in honor of the retiring President. Would not such gatherings tend to bring the members of our Association into closer relationship with each other? For, after all, it is often the spoken word rather than the formal paper that suggests a line of research or is most fruitful in aiding workers in science.

MARCUS BENJAMIN.

U. S. NATIONAL MUSEUM, November 6, 1897.

SCIENTIFIC LITERATURE.

Boletin del Instituto Geologico de Mexico. Nums. 7, 8 y 9. El Mineral de Pachuca.

Since the Geological Survey of Mexico was placed in charge of Sr. J. G. Aquilera, two or three years ago, the work has been prosecuted with great energy and several quarto bulletins, well illustrated, have been issued. These include a sketch of Mexican geology, studies of rocks and fossils as well as studies of special areas.

The volume named at the head of this note gives the results of detailed examination of a well-known region which, more than once, has attracted the attention of European geologists. There are chapters by nearly all members of the staff, illustrated with 8 large maps and diagrams and 6 quarto plates. These describe elaborately the physiography, general geology, veins, and microscopic character of the rocks as well as matters of economic interest.

The district of Pachuca, not far from Mexico, is almost midway in the Sierra de Real del Monte y Pachuca, on the lower half of the westerly slope and near the southwest border of the Sierra. It embraces about 20 square kilometers and its principal mines are in three ravines which unite to form the Rio de Pachuca. Its output of silver in former years was almost fabulous, but since 1895 it has been practically idle, owing to the flooding of the mines. Now, however, the drainage operations promise to be successful and the geological structure of the region becomes of much interest to Mexicans.

The rocks are all eruptives, though sedimentary deposits, most probably Cretaceous, are shown within a short distance. Andesites, rhyolites and basalts are the forms, and of each there occur numerous varieties in texture, color and composition. The chapter on the general geology by Aguilera and Ordoñez gives much detail respecting the macroscopic features of these rocks and their chronological relations. The authors feel justified in concluding that

there have been three periods of eruption since the Middle Tertiary: (1) That of basic andesites, terminating in outpourings of rhyolite. (2) That of spongy porous rocks and ashes, marking the beginning of a tranquil period. (3) That of the basalts, continuous with Quaternary volcanic eruptions in various parts of the Sierra. The second period was marked by circulation of thermal waters in the fissures leading to the deposition of quartz with the sulphides.

The intimate structure of the veins, their variations in relation to the adjacent rocks and to each other, as well as the distribution of ores, are considered in a chapter by the same authors. Sanchez contributes a mathematical discussion of the fracture systems, arriving at practically the same conclusions with Daubree. Ordoñez gives results of investigation of the rocks microscopically, which are illustrated upon a plate. Other chapters by Sanchez, Rangel and Castro discuss the more purely economic features, exploitation, drainage, machinery and metallurgical methods in such a way as to be serviceable to those for whose special advantage they were written.

The volume is creditable alike to the authors and to the Minister of Internal Affairs, who has encouraged the expansion of the work.

J. J. STEVENSON.

Geologic Atlas of the United States, Folio 34. Buckhannon, West Virginia, 1897.

This folio consists of a descriptive text, a topographic map, a sheet of areal geology, one of economic geology, one showing structure sections, and finally a sheet giving a generalized section and table of synonymy. The authors are Joseph A. Taff and Alfred H. Brooks.

The quadrangle comprises an area of 931½ square miles and for the most part is located in the Appalachian coal field near the center of West Virginia, between latitudes 38°, 30′ and 39° and longitudes 80° and 80°, 30′. It embraces portions of Lewis, Upshur, Randolph, Webster, Braxton and Barber counties. The southeastern corner of the quadrangle lies in the district of parallel ridges which characterize the western border of the Great Valley, or central division of the Appalachian province. Rich and Mill, Back Fork, and Point mountains, which attain elevations or more than 4,000 feet, are the principal border ridges here mapped. From these elevated ridges the surface, an inclined peneplain, falls away toward the northwest, down to an elevation of near 1,700 feet. Six rivers have their sources within this quadrangle, West Fork of Monongahela, Buckhannon, Middle Fork, Valley, Little Kanawha, and Elk, all belonging to the Ohio drainage. These rivers, having their powers of corrasion augmented by the elevated and tilted surface of the country, have dissected the once nearly first country by deep, narrow channels.

The stratigraphy column makes a section of about 4,600 feet of rock. Sixteen hundred feet of interstratified Devonian sandstone and shale are divided nearly equally between the Jennings and Hampshire formations. Of the Lower Carboniferous there are about 1,100 feet, of which less than 100 feet is Pocono sandstone; 350 feet of Greenbrier limestone, and 650 feet of red shale, brown sandstone and conglomerate, making the Canaan formation. The remaining 1,900 feet comprises the coal measures known in this folio as the Pickens sandstone, Pugh formation, Upshur sandstone and Braxton formation, which are composed of conglomerate, sandstone and shale with beds of coal.

The structure of this district is typical of the two provinces which it includes. In the southeastern portion, east of Rich Mountain, the structure is that of the folded region of Great Valley, which is characterized by long parallel anticlines and synclines with north-southwest axes. West of Rich Mountain the typical Cumberland Plateau structure prevails. Here the strata are slightly inclined and gently folded.

The only product of economic importance is coal, of which there are seven workable beds. Two of these occur in the Pickens sandstone, three in the Upshur sandstone and two in the Braxton formation. The coals are from two to six feet thick. They have not been worked on a commercial scale, because other areas of productive coal lie between this field and the seaboard and nearer to large centers of coal consumption, both north and west.

On the economic sheet of the folio structural contours at intervals of 100 feet are represented by white lines. These, as drawn, represent the inequalities of the upper surface of the principal coal bed in the Upshur sandstone. The thickness of the strata being known, it is evident that the position of any other coal seam or bed may be determined from this datum plain.

Laboratory Manual of Inorganic Chemistry. By RUFUS P. WILLIAMS, in charge of the Chemical Department of the English High School, Boston. Boston, Ginn & Co. 1896.

This book, which is intended especially for use in elementary schools, is arranged so that each page is devoted to a separate topic. The alternate pages are left blank for notes and the experiments are unusually full of minute directions. This minuteness of directions may be well in the case of one who is working alone and can use the book to aid him in difficulties; but when working under the eye of the instructor it is questionable whether such close attention to details given in the book and, as in this case, working by rules is not apt to make the student too dependent, instead of teaching him to observe for himself and to devise, to a certain extent, the methods of work he shall follow in each experiment. The free use of symbols in other than equations is especially objectionable in the early stages of the study, as the student becomes impressed with the idea that proficiency in the use and manipulation of chemical symbols is the thing to be acquired and not the principles of the subject. Difficulties encountered and overcome by the ingenuity of the student are a great incentive and give him confidence in his own powers. After taking up in order the common non-metallic elements, the author gives the usual methods of separating the members of the different groups of metals. These are given without any preliminary study of the different members of the groups, which would enable one to understand the principles upon which the separations are based and must be entirely mechanical in their nature. No text-book is recommended for use with this laboratory guide, and while it can probably be used with good results in many cases it must be with the constant attention of the teacher and the elimination of some features, especially the part relating to the separation of the metals.

J. E. G.

Elements of Chemistry. By RUFUS P. WILLIAMS, in charge of the Chemical Department of the English High School, Boston. Boston, Ginn & Co. 1897.

The title of this book is rather a misnomer, as the author has gone beyond the capacity of an elementary student and has introduced much matter which would only bewilder a beginner in the subject. As he says in the preface, 'the division of matter into coarse and fine print enables a choice to be made' according to the needs of the class. He is a strong advocate of graphic methods of representing compounds, and 'and many topics—such, for example, as valence, etc.—have been treated in quite an original manner.' On turning to this chapter we find that he represents valence graphically 'by using cubical kindergarten blocks with small screw-eyes and hooks' to represent the bonds and their method of attachment. Before studying the simplest element he instructs the student in the methods of writing symbols and finding molocular weights by rule. The subject, omitting the theoretical part, is treated in a very thorough manner for an elementary book; but the arrangement, especially that of the non-metals, is not as systematic as it might be. The latter part of the book contains an account of some common organic substances and a chapter on the chemistry of fermentation and of life.

J. E. G.

Congreso Internacional de Americanistas. Actas de la Undecima Reunion, Mexico, 1895. Mexico, 1897. 1 Vol. Pp. 576.

The previous volumes of the International Congress of Americanists all contain some valuable articles and all a good deal of trash. In both these respects the present Compte-rendu resembles its predecessors. Why people who pretend to be scholars still want to publish articles showing that the name of the Atlas mountains is derived from the Nahuatl 'Atlan;' that the Otomis are related to the Chinese; that the cross of Palenque is a proof of Buddhistic

worship in America; that the 'Toltecs' spooked around Central America; that the fables of the Aztec story-tellers can be assigned local existence, and the like, is hard to understand; and why a scientific society spends its money in publishing such stuff would be more inexplicable did we not all appreciate the importance of not offending the genial members of such reunions.

Fully half this volume is taken up with such padding and with second-hand material. Rather than occupy the reader's time with a discussion of it, it will be more profitable to mention some of the really valuable contributions to American studies, which are between the covers of the nearly six hundred pages.

Naturally we look for special attention to the Nahuatl language. Nor are we disappointed. The Rev. Hunt Y. Cortes, distinguished by his previous studies in this tongue, offers a number of specimens of the classical idiom, with excellent analyses and grammatic observations; Don José Maria Vigil called attention to the ancient Mexican songs still extant, and Don Mariano Sanchez Santos, an accomplished Nahuatl scholar, gave translations of several of them. Lauro Castanedo sent copies of a few old religious manuscripts in a dialect, evidently corrupt, of the ancient tongue. Other linguistic memoirs are presented, one from Dr. Pimentel, on the present classification of the Mexican languages; a catalogue of periodicals published in North American native tongues, by Sr. Cesare Poma; a valuable grammatical sketch of the Guaraouno tongue, by M. L. Adam; two by M. Raoul de la Grasserie, on the Auca and the Yunga; a comparison of the Huasteca and Nahuatl, by Alvarez y Guerrero, and several rather wild flings at the derivations of some native names.

The only contribution of moment offered to the study of the hieroglyphic writing was a paper by Dr. Nicolas Leon on the employment of a script of the kind, of course devised by their European teachers, among the Otomis, in a period long after the Conquest. We learn from this memoir that the spiritual fathers did all they could to keep the Indians in ignorance of white civilization, and thrashed them if they tried to learn Spanish!

The papers on the ancient monuments are moderately full. Señor Rodriguez describes the pyramid of Tepozteco at length, and Mr. H. S. Jacobs, in a somewhat flowery style, runs over the cliff-dwellers and the 'dead empires, the wonderful evidence of prehistoric life, to be found in Mexico!'

Some minute questions in Mexican history are elucidated, and Mr. Thomas Wilson advances various reasons showing the great antiquity of man in America. Professor Mariano Barcena submits again the evidence for the prehistoric man of the valley of Mexico, our old friend, the 'Hombre del Peñon,' about whom our departed colleague, Professor Cope, became skeptical in his latter days.

There are some other articles in the volume, good in the way of compilations; one on the media of exchange of ancient Mexico, by Mr. J. W. Bastow; one on the ancient commerce of Yucatan, by the late Bishop Carrillo Ancona; on the medical knowledge of the Aztecs, by Alatriste de Lope; and others of minor importance.

Although the scientific value of the volume may be disappointing, the foreign associates were unanimous in their sincere recognition of the generous hospitality they received from the Mexican government and citizens; and it is very creditable to the Committee of Publication that the volume has appeared thus promptly, while the report of the Congress in Stockholm, in 1894, to employ a Gallicism, still 'lets itself be waited for.'

D. G. Brinton.

Totem Tales. W. S. Phillips. Chicago, Star Publishing Co. 1896. Pp. 326.

The present book pretends to be a collection of myths from the coast of the North Pacific Ocean. The author says: "The stories contained in this little volume under the title of 'Totem Tales' are the result of careful study and research among various tribes of Indians of the Northwestern Pacific Coast. The Indian peculiarity of narration is kept, as nearly as possible, consistent with an understandable translation from the native tongue into English." If it were not for these claims the book might pass unnoticed, but since the author's expressions might be taken seriously it may be well to

sound a note of warning. Nothing can be less Indian than the words in which the tales are couched, nothing more misleading than the illustrations which represent the Indians of the coast as living in tepees and dressed in the style of Indians of the plains. The few sketches of Indian masks and paintings are given fanciful interpretations. Most of the stories are highly modified versions of stories from the region between Columbia River and Alaska, but the author has also introduced the Sedna legend of the Eskimo of Baffin Land (see Sixth Annual Report Bureau of Ethnology, p. 583 ff.) under the title 'Cawk, the Beaver's Daughter.' The figures representing the thunderbird (pp. 286 ff.) have been taken from the Tenth Annual Report of the Bureau of Ethnology (p. 483) and belong to a variety of tribes. As a representation of Indian life and thought the book is entirely misleading.

FRANZ BOAS.

SOCIETIES AND ACADEMIES.

THE NEW YORK SECTION OF THE AMERICAN CHEMICAL SOCIETY.

THE regular November meeting of the New York Section of the American Chemical Society was held on the 5th, at the College of the City of New York. A paper on 'Corrected Assays' was read by E. H. Miller, and on the 'Chemistry of Formaldehyde in Disinfection with Exhibits' by Dr. E. J. Lederle.

Apparatus was exhibited for the production of formaldehyde in house disinfection, and an active discussion followed on its chemical properties, methods of estimating strength of solutions, effects of impurities, etc. It was stated that none of the so-called 40% solutions contain more than 33 to 36% of formaldehyde, and on account of the numerous impurities the specific gravity is no guide to the strength of the solutions. Its combination with glue was said to be perfectly stable, and if once thoroughly dried, perfectly insoluble.

A paper on the 'Chemistry of Substance used in Perfumery' was announced for the next meeting, and an interesting exhibit of natural and synthetic products is anticipated.

DURAND WOODMAN,
Secretary.

NEW YORK ACADEMY OF SCIENCES—SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

THE Section meets bi-monthly at the Mott Memorial Library. The first meeting of the fall was held Monday evening, October 25th. Professor Cattell presented a report from the pen of Professor A. C. Haddon, of England, on Anthropology at the Toronto meeting of the British Association, and Dr. A. Hrdlicka reviewed the work in Anthropology and Psychology at the American Association.

Dr. Franz Boas and Dr. Livingston Farrand made a preliminary report of their work during the summer on the Jesup expedition sent out by the Museum of Natural History.

Their work was mainly among two of three tribes in the western part of British Columbia. Many interesting details were brought out with reference to tribal organization, language, customs and traditions. Attention was called to the rapid changes going on as a result of their location upon government reservations.

The general plan of the work undertaken by the Museum was outlined by Dr. Boas. It will extend over a period of years and will include an exhaustive study of the tribes on the northeastern coast of Asia as well as all the remaining tribes on the northwestern coast of America.

The next meeting of this section of the Academy will be held on the last Monday in January.

C. P. BLISS,
Secretary.

NEW YORK UNIVERSITY.

SCIENTIFIC JOURNALS.

American Chemical Journal, November.—'The Action of Carbon Dioxide upon Sodium Aluminate and the Formation of Basic Aluminium Carbonate,' W. C. DAY: Evidence in favor of the existence of a carbonate of aluminium. 'Aliphatic Sulphonic Acids,' E. P. KOHLER: General methods of preparation of the unsaturated aliphatic sulphonic acids. 'The Dissociation of Electrotypes as Measured by the Boiling-Point Method,' H. C. JONES and S. H. KING. 'On Diacyl Anilides,' H. L. WHEELER, T. E. SMITH and C. H. WARREN: Crystallographic study. 'Synthesis of Hexamethylene

Glycol Diethyl Ether and and other Ethers from Trimethylene Glycol,' A. A. NOYES. 'On the Chloronitrides of Phosphorus,' H. N. STOKES: Isomeric series of compounds. 'Preliminary Paper on the Composition of California Petroleum,' C. F. MABERY. 'On the Solubility of Ammonia in Water at Temperatures below 0°C,' J. W. MALLET. 'Note on a Somewhat Remarkable Case of the Rapid Polymerization of Choral,' J. W. MALLET. This number also contains obituary notices of Victor Meyer, Paul Schutzenberger and C. Remegius Fresenius.

J. ELLIOTT GILPIN.

Journal o the American Chemical Society, November.—'The Solubility of Stannous Iodide in Water and in Solutions of Hydriodic Acid,' S. W. YOUNG. 'On Iodostannous Acid,' S. W. YOUNG. 'A Comparison of Various Rapid Methods for Determining Carbon Dioxide and Carbon Monoxide,' L. M. DENNIS and C. G. EDGAR. 'The Electrolytic Determination of Cadmium,' DANIEL L. WALLACE and EDGAR F. SMITH. 'On the Reactions between Mercury and Concentrated Sulphuric Acid,' CHARLES BASKERVILLE and F. W. MILLER. 'On the Determination of Fat and Casein in Feces,' HERMAN POOLE. 'The Principal Amid of Sugar Cane,' EDMUND C. SHOREY. 'The Influence of Antiseptics on the Digestion of Blood Fibrin by Pepsin in a Hydrochloric Acid Solution,' CHARLES F. MABERY and LEO GOLDSMITH.

The Botanical Gazette, November.—'Notes on the Fecundation of Zamia and the Pollen Tube Apparatus of Ginkgo,' HERBERT J. WEBBER: In continuation of previous papers calls attention to some of the peculiar phenomena which occur during the process of fecundation and to features in the development of the pollen tube apparatus of Ginkgo, and the origin of the centrosome-like bodies. 'North American Species of Amblystegium,' LELLEN STERLING CHENEY: Describes sixteen species, of which ten are found both in Europe and North America, one in North America and Japan, and five exclusively in North America. 'Vernation of Carya,' WILLIAM WHITMAN BAILEY. 'Abnormal Leaves and Flowers,' T. D. A. COCKERELL. 'Stomata on the Bud Scales of Abies Pectinata,' ALEXANDER P. ANDERSON.

The American Geologist, November. — 'On Streptelasma profundum (Owen), S. Corniculum Hall,' F. W. SARDESON. 'The Koochiching Granite,' ALEXANDER N. WINCHELL. 'On the magnetite belt at Cranberry, North Carolina, and Notes on the Genesis of this iron ore in general in crystalline schists,' JAMES P. KIMBALL. 'Diceratherium Proavitum,' J. B. HATCHER. 'The Fisher Meteorite, Chemical and Mineral Composition,' N. H. WINCHELL.

NEW BOOKS.

Traité de zoologie. Edited by RAPHAEL BLANCHARD. Fascicle XI., Némertiens, Louis Jouben, pp. 54, with 35 figures. Fascicle XVI., Mollusques, H. Paul Pelseneer, pp. 187 with 157 figures. Paris, Schleicher Frères. 1896.

Traité de zoologie concrete. IVES DELAGE and EDGARD HÉROUARD. Tome I. La Cellule et les Potozoaires. Paris, Schleicher Frères. 1896. Pp. xxx+584.

L' Année Biologique. IVES DELAGE. Paris, Schleicher Frères. 1897. Pp. xlv+732.

La vie mode de movement. E. PRÉAUBERT. Paris, Felix Alcan. 1897. Pp. 310.

Popular Scientific Lectures. ERNST MACH. Translated by THOMAS J. MCCORMACK. Chicago, Open Court Publishing Co. 1897. Second edition, revised and enlarged. Pp. 382. $1.00.

Teaching as a Business. C. W. BARDEEN. Syracuse, N. Y., Bardeen. 1897. Pp. 154.

Industrial Freedom. DAVID MACGREGOR MEANS. New York, D. Appleton & Co. 1897. Pp. vii+248. $1.50.

Birdcraft. MABEL OSGOOD WRIGHT. New York and London, The Macmillan Co. 1897. Pp. 317. $2.50.

The Elements of Electric Lighting. PHILIP ATKINSON. New York, D. Van Nostrand Company. 1897. Pp. vi+275. $1.50.

Social and Ethical Interpretations in Mental Development. JAMES MARK BALDWIN. New York and London, The Macmillan Co. 1897. Pp. xiv+574. $2.60.

SCIENCE

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N Y.

RESULTS OF THE BERING SEA CONFERENCES.

THE Fur-Seal Conferences recently held at Washington by representatives of the governments of Great Britain, Russia, Japan and the United States are noteworthy in several respects. The high character and fitness of the delegates, the rapidity with which the negotiations were carried to a successful conclusion, and the essential agreement reached on the principal points under discussion, are matters for international congratulation. It will be remembered that Great Britain declined to take part in a joint conference in which Russia and Japan were to be represented. This led to the holding of two distinct conferences—the first with Russia and Japan; the second with Great Britain and Canada. In the first there were few if any points of dispute, and an agreement was promptly reached whereby the governments of the United States, Russia and Japan pledged themselves to desist from pelagic sealing for a period of one year, pending subsequent negotiations.

In the second conference the conditions were entirely different, the matters under discussion between Great Britain and the

United States having been the subject of international controversy for a number of years. It will be remembered that both countries have been represented at the Pribilof Islands by experts during the past seven years, and that the members of the original Bering Sea Commission of 1891 (Professor T. C. Mendenhall and Dr. C. Hart Merriam for the United States; Sir George Baden Powell and Dr. George M. Dawson for Great Britain) failed to agree on the facts of seal life at the islands. It will be remembered also that in subsequent years the reports of the experts representing the two countries differed materially as to the condition of the rookeries and habits of the seals. These facts, in connection with the hostile attitude of the press of the contending countries and the anxiety over the outcome felt by both governments, give to the findings of the conference an interest and importance quite out of proportion to the real weight of the points at issue.

Great Britain was represented by Professor D'Arcy W. Thompson, of Dundee; Canada, by Mr. James M. Macoun, of the Canadian Geological Survey; the United States, by Dr. David Starr Jordan, President of Stanford University, and the Honorable Charles S. Hamlin, formerly Assistant Secretary of the Treasury. The conference was notable for its brief duration (the sittings occupying only seven days) and for the essential accord of the scientific experts respecting the numbers, condition and habits of the fur seals.

The case was one where naturalists of reputation, who had personally studied the fur seals at the islands, were called upon to make a joint report on matters that had been in controversy for many years, that had led to strained relations between the governments concerned, and respecting which diverse opinions prevailed among the people and the press. The important fact must not be overlooked that the people and the press of Great Britain and Canada have not up to the present time understood the real facts in the case, and that in combating the attitude of the United States they have done so largely through misinformation. It is important to bear in mind, therefore, that the British and Canadian experts in signing the joint report are liable to incur the displeasure of their countrymen, who may regard the report as a concession to the United States. The greatest credit is due them for making a straightforward statement of fact, irrespective of public prejudice.

The delegates had no power to recommend remedial legislation, their duty being to submit a joint report on the facts on which they could agree as to the condition and habits of the fur seals. With these facts before them, it is hoped that the two governments will find little difficulty in framing measures necessary for the permanent protection and preservation of the seal herd. That such measures involve the ultimate cessation or limitation of pelagic sealing is a fair inference from the report of the expert delegates. That Canada, having no rookeries of her own and consequently no opportunity to profit by the sealing industry except as carried on in the open sea, will voluntarily relinquish pelagic sealing without some offset or concession on our part, can hardly be expected. The

friendly attitude of the two governments as shown by recent events leads to the hope that the whole matter may be amicably adjusted. In any event, the complete agreement of the naturalists taking part in the conference may be regarded as a triumph for science.

The essential features of the propositions agreed upon are as follows :

That since 1884 the Pribilof herd has declined from year to year until at present the number of seals is not more than one-fifth to one-third as great as formerly, although the number of breeding females in 1896 and 1897 was between 160,000 and 130,000. It is also agreed that there has been a notable decrease since 1896, although the exact amount of this loss could not be determined. The existence of a high death rate among the young from natural causes is acknowledged and the conclusion reached that not more than one-half or one-third reach the age of three years.

To those who are acquainted with the various reports on the subject the latter figure will seem nearest the mark, and the evident inference would be that if the death rate in nature is so great any addition to it by such causes as pelagic sealing, with the consequent starvation of thousands of young, is bound to reduce the seal herd. The methods of driving and killing as practised on the islands, it is stated, call for no comment, and it is admitted that land killing as now carried on does no harm.

This is one of the points on which the press of both England and the United States has been more or less confused and, in spite of all that has been written on the fur seal during the past few years, there seems to be a vague suspicion that after all land killing may have had something to do with the decrease of the herd. This matter was fully discussed in the preliminary report of 1896, where it was very clearly shown that as the fur seal is polygamous and the harems even now, when the number of females has been greatly reduced, contained on an average thirty females to one male, it is evident that, the birth rate being equal, there is a vast superfluity of males.

It is acknowledged that the catch at sea contains a marked excess of females, and this is a most gratifying admission to those who have read the statements made by the sealers, in which the number of males taken was frequently reported to be as great as that of the females and sometimes even greater, a remarkable state of affairs when it is remembered that, owing to the killing of young males on land and the fact that the nursing females are compelled to go to sea in search of food at a time when the males are on shore, the females are bound to be greatly in the majority.

On the other hand, it is pointed out that not all these females are nursing or pregnant, for the reason that many adult seals have lost their pups through the natural causes, while a certain percentage is bound to consist of yearling and two-year-old females.

The conclusion that excessive pelagic sealing has lead to a decrease in the herd is coupled with the axiomatic statement that a small number of females, less than the annual increment of breeders, might be taken without producing actual decrease.

As this annual increment is at the best small and as for ten years there has been a steady loss, it seems apparent enough that the number that might be taken with safety has been very much exceeded.

It is conceded that pelagic sealing has of late fallen off in a greater ratio than the herd, thus producing a tendency toward equilibrium in numbers. This simply means that over 60,000 seals were taken in 1895; 43,000 in 1896, and 26,000 in 1897, so that the pelagic catch has fallen off one-half in three years, although the herd has not diminished by one-half in the same time.

It is to be feared that before any equilibrium could be reached but a small portion of even the present number would be left, and this leads naturally to the next point agreed upon, which is that in estimating the future conditions of the herd the reduction in the number of pups caused by the pelagic catches of 1894 and 1895 must be taken into consideration.

For example, not less than 20,000 pups, half of them females, perished of starvation in 1895, owing to the death of their mothers from pelagic sealing. Not only did the portion of this number that would have survived fail to appear on the rookeries in 1897, but the number of births will be naturally lessened by just that number in 1898 and the progeny of these in turn fail to appear in 1900. Thus, as the natural decrease will go on, while the natural increase has been cut off, effects of pelagic sealing will be felt up to 1900, even should it be stopped at once.

The final conclusion is that the herd is not in danger of actual extermination so long as its haunts on land are protected and the protected zone about the islands is maintained, and that both land and sea killing now yield an inconsiderable profit. The seal herd is in fact very far from actual extermination, although the point of commercial extermination, or that where the returns are wholly incommensurate with the amount of capital invested, has been nearly reached. But for the prompt action of the United States in 1869 this point would have been reached years ago, while but for its care of the islands ever since practical extermination would not be far off.

The example of the Southern fur-seal illustrates the rapidity with which commercial extermination may be effected, while the fate of the fur seals on the Farallones, Guadalupe and Juan Fernandez shows how readily actual extermination may take place. The Pribilof Islands are not, like those of the Antarctic, difficult of access, and their abandonment by this government would lead to the actual extirpation of the fur seals within a very few years. On the other hand, with proper protection the fur-seal herd can, with but little care and cost, be made an important source of revenue so long as fashion may decree the wearing of of seal-skin sacques.

THE PSYCHOLOGY OF THE PERSONAL EQUATION.

In the present paper the writer proposes to maintain the thesis that the personal equations of astronomers are mainly controlled by known laws of experimental psychology and hopes to assist his professional brethren in making use of the researches of the psychologists in such a manner that they shall avoid groundless hypotheses

which have often been harmful by leading to premature conclusions and thus have hindered the progress of our knowledge.

I do not wish to be considered as denying the possibility that the psychologists may learn something from the steady and well understood routine of the astronomers in their practical operations. In truth, almost the first step towards the measurement of the times occupied by mental processes was taken by the great astronomer Bessel in his classical memoir on 'Personal Equation,' which is reprinted in the third volume of Engelmann's edition of his 'Abhandlungen.' Bessel indicated there very clearly that the cause of the riddle which he partially solved was a psychical one, namely, the impossibility of comparing the impressions on two senses, sight and hearing, which take place exactly at the same instant. The 'eye and ear' observer who uses Bradley's method as modified by Maskelyne in noting down the time when a star image passes a fixed thread in his telescope makes the attempt to combine these two impressions, and in so doing necessarily 'apperceives' one of them before the other, and this produces 'personal equation,' or constant error in the time, which in seconds and fractions he notes down in his observing book. Bradley, in his journals of observation, noted vulgar fractions of the seconds. Maskelyne, Bradley's successor, failed to discover even the facts of personal equation, except in the work of one of his assistants. This case, that of Kinnebrook in 1795, was apparently settled by discharging the poor fellow as irregular and 'vitious' in his methods of observing. The personal equations of Maskelyne's other assistants were not known till many years later; Bessel's discovery, made about 1820, originated in his reading Maskelyne's notes about Kinnebrook's apparent want of skill. After the publication of Bessel's memoir the matter was followed up by W. Struve, Airy and other eminent astronomers, before the invention of the chronograph in 1849 had become the common property of astronomers. It led very soon to the thought that something similar had place in chronographic registration. This suspicion was fully confirmed before or soon after the 'American Method' was introduced at Greenwich.

In 1861 the psychological side of the investigation was taken up by Professor Wundt and led to the important discovery of the displacement of time when the observer attempts to fix the place on a divided scale of a continuously moving object. This displacement of time can lie in either direction, and thus an apparent difficulty is relieved which arises from the facts of personal equation as observed by Bessel, W. Struve and Argelander, and also by the astronomers who took part in Struve's chronometric expeditions of 1843 and 1844. The regular Greenwich investigations began with Airy's entrance upon the office of Astronomer Royal, in 1835, and have been continued to the present day.

The attempts by means of personal equation machines to determine the absolute personal equations of eye and ear observers led to the general result that most observers anticipate the true time of the transit, and that those who, like Argelander, fall behind it are fewer in number. If we take the average observer as the standard, as Sir George Airy seems to have intended, we find but few of those tested between 1835 and 1859 who fell behind the standard observer for the time, or behind the average of the body of observers in employment together at Greenwich. In my paper in the *Monthly Notices* of the Royal Astronomical Society for May, 1897, I have shown that the Greenwich observers since 1885 have anticipated their own times of chronographic transit by an amount not far from $0^s.13$, on the average. One excellent observer,

Mr. Hollis, anticipates his own chronographic transit by $0^s.5$, and does this, not because his eye and ear anticipation of the true time is very large, but because he employs the slower method of registration, first pointed out, if I mistake not, by Le Verrier, and his chronographic transits are about $0^s.2$ later than those of the average observer. The difference $0^s.13$ between the average observer's eye and ear transits and chronographic is about the average time of a 'simple reaction' according to the psychologists, and thus its amount confirms Wundt's view that chronographic registration by a practiced observer is closely analogous to the process of simple reaction. We thus reach the conclusion that the anticipation of such an average observer, added to the positive time which he requires to make a registration, is but $0^s.13$, and a partial compensation would take place if the two methods were used in connection. The best form of personal equation machine is, as it appears, the Repsold Transit Micrometer. The tests which have been made of it, as of other contrivances for a similar end, are not entirely conclusive for various reasons, and the chief of them in this case seem to arise from the novel construction of the instrument and the short experience of the observers with it.

I quote from the *Astronomische Nachrichten*, No. 3,036, the following differences chronograph-Repsold Micrometer for Professor Becker and his colleagues :

	Chronograph-Repsold Micrometer.	Mean Error.
Becker	$+ 0^s.319$	$\pm 0^s.009$
Halm	0.224	0.009
Kobold	0.110	0.011
Zwink	0.158	0.016

These personal equations are of the same general order of magnitude as the reaction times found by a multitude of psychological experimenters. The largest differences among them may without much danger be ascribed to the same cause as the chronographic personal equation between Mr. Lewis, now standard observer at Greenwich, who employs the quicker method of registering, and Mr. Hollis, who employs the slower; their average differences for ten years is $0^s.24$, varying very little from year to year, and that between Dr. Kobold and Professor Becker is $0^s.209$ by the data given above and $0^s.255$ by direct chronographic registration. The former registers rapidly and the latter slowly, but they do not give in the article cited any account of their psychical process.

Wundt, in his classical work 'Grundzüge der physiologischen Psychologie,' expresses the decided opinion that astronomers will do well to study the methods of the psychologists in dealing with personal equations, and this conviction I venture to consider as confirmed in a definite numerical way in my paper in the *Monthly Notices* to which I have referred. Additional arguments in favor of the psychological conclusion are not wanting and will be briefly stated. In the first place eye and ear observers note the times of transits differently when they observe stars on different sides of the zenith. There does not appear to be any certain general rule as to the sign of this form of equation. Chronographic observers register transits of time stars about $0^s.02$ or $0^s.03$ later when the direction of motion is opposite to the usual one. This agrees with the psychical law that unfamiliar circumstances tend to delay reaction. Faint stars are observed by chronograph later than brighter ones. This delay, about $0^s.013$ per magnitude, has been tested by several of the most eminent observers now living and found to increase in amount as the stars approach that magnitude at which they are observed with difficulty by a given transit instrument. A similar delay in reaction to a sense impression, not a linear function of the intensity of the sense

impression, is found to be shown when the sense impression is faint. Even the amount $0^s.013$ per magnitude is approximately indicated by the experiments of G. O. Berger and Professor Cattell, who have found, for a diminution in intensity to one-thousandth of its normal amount, a delay in the reaction to impressions on the sense of sight by $0^s.113$ for himself as reagent and $0^s.108$ for Dr. Cattell. The diminution in intensity corresponds to seven and one-half magnitudes on the usual astronomical scale: $7\frac{1}{2}=\log. 1000 \div 0.40$ and the quotients $0^s.113 \div 7\frac{1}{2}$ and $0^s.108 \div 7\frac{1}{2}$ are approximately $0^s.013$.

The eye and ear transits of very faint stars are liable to singular variations of personal equation; sometimes they are noted relatively too late and sometimes too early. Argelander suspected this last variation for himself and Auwers has proved it, and Argelander's explanation fits the phenomena as observed. He considers that according to Bessel's theory he 'first saw' and 'then heard,' but that when the star was very faint this displacement of time was reversed in direction. For stars not below the limit of magnitude where observation is easy this reversal did not take place. Auwers has shown that in similar cases Bauschinger observed very faint stars too soon by about one-tenth of a second of time. The reversal in Argelander's case produced a variation a good deal larger for extremely faint stars than Bauschinger's, but for either observer the fact of reversal is highly probable. In my paper before cited I give only a part of the details of the Greenwich observers' two-method personal equations. Those details which I do give indicate very clearly that the two-method personal equation varies from year to year, as had been previously found by Dr. Hilfiker, A.N., No. 2815. For example, Mr. Crommelin anticipated his own chronographic transits by $0^s.20$ in 1892 and by $0^s.10$ in 1893. Mr. Bryant by 0.07 in 1892 and $-0^s.01$ in 1893. Similar variability from year to year is indicated in the work of the veteran observers, H.T., A.D., T.L., and H., for whom only average values are given in my paper. Nor are such alterations of personal equation confined to the eye and ear personal equation or its difference from the chronographic. Professor Turner, Chief Assistant, anticipated Mr. Downing with the chronograph by $0^s.15$ in 1886 and by $0^s.08$ in 1888. Mr. Lewis, now 'standard observer,' anticipated Mr. Downing by $0^s.01$ in 1886 and $0^s.10$ in 1891, and similar changes are visible in the eye and ear personal equations relative to the standard observer of the year. The instrument and stars were essentially the same for all the years between 1885 and 1893, so that the changes in the two-method personal equations are psychical variations in the habits and methods of registration and of noting eye and ear transits. The study of these habits and methods is plainly a branch of experimental psychology. We have already obtained some indications of how astronomers can promote this branch of study to their professional benefit as well as to that of psychological science. The simplest way for them to proceed is first of all to make more extensive comparisons of the eye and ear and chronographic method than have already been accomplished. Such comparison of eye and ear and chronographic transits of stars of various magnitudes would with little trouble extend our knowledge of the subject to a considerable degree. The Greenwich astronomers have detected the 'Gill equation' in chronographic transits; especially with the altazimuth. The same form of personal equation has been found in Professor Küstner's Berlin observations and by Mr. Tucker, of the Lick observatory, in his own. The 'Helligkeitsgleichung' for chronographic transits is, as before stated, already well

known and exhibits some uniformity. The great observatories which still so effectively employ the eye and ear method have a wide field of investigation open to them for the places of unknown stars which are not too faint to be more advantageously observed by eye and ear than by chronograph. Of course, immediate micrometrical measurement would give us enough material for completely settling the 'Helligkeitsgleichung' for most living astronomers. Stars within five degrees of either pole can now be observed by the Greenwich method, and the doubts and perplexities which hinder the accurate study of their right ascensions will soon vanish.

The Repsold micrometer, already an indispensable tool in determinations of longitude, is not well enough known to enable the observers to omit the exchange of their own stations and instruments.

But the numbers obtained by its use cannot, I suppose, yet be called absolute personal equations, but from them I venture to guess that the difference between the largest 0.319 for Professor Becker and the smallest 0.110 for Dr. Kobold implies that Professor Becker employs the sensorial or deliberate form of registration and Dr. Kobold the motor or shortened form; as the difference between them, $0^s.209$ with a mean error of 0.014, is nearly equal to that of $0^s.24$ between Messrs. Lewis and Hollis at Greenwich from eleven years' comparisons, 1883–1893.

The conclusion which some astronomers appear to favor, that by Bradley's method, as well as by the chronographic, faint stars are observed relatively later than brighter ones, is shown not to be a safe one, because we have cited two examples of thoroughly skilful observers who observe very faint stars earlier than those whose observation by eye and ear is easiest and most accurate. There is also a series of 'Coefficients of the light equation collected by Professor Auwers in his Berlin Zone of the A. G. C.,' in which there is so little uniformity even as to sign that he is led to remark upon the uncertain and fragmentary nature of the results in this matter; so far as obtained by astronomers. If the eye and ear observer is careful not to observe transits of stars too faint to be seen in the illuminated field, we are partially justified in concluding with Bauschinger that the 'Helligkeitsgleichung' is not then a sensible form of personal equation for eye and ear work, and we can also conclude that it deserves attention chiefly in its psychical aspect and that the method of making good eye and ear observations of transit is to make sure by ingrained habit of the uniformity of the psychical process from star to star, especially when the attempt is made to determine the right ascension of faint stars like the fainter ones of the 'Durchmusterung.'

The writer is not aware that any other astronomer has made the attempt to compare the numerical results of the psychologists with the personal equations as determined in the usual routine of observatory work, and is inclined to recommend the continuance of such comparisons in directions which at once suggest themselves.

First. Comparisons of eye and ear and chronographic transits of stars in various magnitudes and declinations.

Second. Comparisons of observations by both methods with the Repsold Transit Micrometer.

The subject of this paper is so broad and goes so deeply into many problems of practical astronomy where high accuracy is aimed at that the writer can only express regret that his attempts to deal with the matter have been so inadequate, and hopes that at a future time he may be able to prosecute it farther by the kind assistance of his colleagues and pupils.

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THE PROGRESS AND ACHIEVEMENTS OF HYGIENE.*

HYGIENE is a department of medicine whose object is the preservation and promotion of health and deals, therefore, with all the various factors likely to influence our physical welfare. It is not an independent science, but rather the application of the teachings of physiology, chemistry, physics, meteorology, pathology, statistics, epidemiology and bacteriology to the maintenance of the health and life of individuals and communities. The subject is very properly divided into personal and public hygiene. In the former the doctrines are applied to individuals, in the latter to communities.

This branch of medicine has received such an impetus within the last twenty-five years that many persons regard it of modern origin; such, however, is not the case, for on turning to early history we almost invariably find that the health of the population has been made a subject of legislation. Hygiene was practiced by the Egyptians, who paid special attention to their diet and the care of children; they knew the dangers of floods to health, and resorted to preventive measures against their occurrence, as well as against the spread of contagious diseases.

The old Indians paid special attention to diet, habitation, exercise and the isolation of children in case of infectious diseases. The Mosaic code of laws contains minute directions for the cleanliness of the person, the purification of the dwelling and camp, the selection of healthy and avoidance of unwholesome food, the seclusion of persons with contagious diseases, the regulation of sexual functions, etc. The sanitary code, especially that part which relates to the slaughtering of animals, the food supply, its preparation, care of utensils for cooking, eating and drinking, personal cleanliness and frequent ablutions of the hands, appear peculiarly appropriate, since our knowledge of infectious disease germs, and it is a singular fact that, from some cause or causes, this race presents an endurance against disease that does not belong to other portions of the civilized communities amongst which its members dwell.

This resistance dates from the first to the last periods of life. Hoffmann finds that in Germany the number of still-born amongst the Jews was 1 in 39, and of the other races 1 in 40. Mayer determined that Hebrew children from one to five years of age die in the proportion of 10% as against 14% among the Christian children. After the fifth year the value of life still continues in favor of the Jews; the average duration of the life of the Jew being 48 years and 9 months, and of the Christian scarcely 40 years. In the census statistics of 1890, Dr. Billings has investigated the subject and developed the fact that the death-rate among the Jews in our own country is very low, being only 7.11 per 1,000, a little more than one-half the annual death-rate among other persons of the same social class and conditions of life, but the facts of most interest brought out are the low marriage rate, 7.4 per 1,000, as compared with 18 to 22 per 1,000 among the general population, and the low birth-rate, which was 4.66 for each mother. The number of Jewish children under 5 years of age in this country is therefore less, being in the proportion of 9 to 13, of the average population, but from 5 to 15 years it is greater in the proportion of 29 to 23. The causes for the higher vitality of the Jewish race have been earnestly searched for, because that race which presents the strongest vitality, the greatest increase of life and the longest resistance to death must in course of time become dominant. The causes may be summed up in the term

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'soberness of life.' The Jew drinks less than his Christian brother; he takes as a rule better food; he takes better care of his poor and he takes better care of himself. How much his sanitary code of laws has accomplished in this direction I will not undertake to estimate.

A study of the habits of the primitive peoples in different parts of the globe shows that a desire to prevent disease is innate to all men. Among matters of personal hygiene may be mentioned massage for the purpose of overcoming fatigue, ocean, river, hot-air and vapor baths as practiced among many Indian tribes, the employment of eye-protectors against the glaring effects of snow among the inhabiants of the Arctic region, the use of respirators by the Kwixpagmut, an Eskimo tribe, to prevent the inhalation of smoke during their sweat baths. (Max Bartels, p. 222).

Many of our North American Indians have their medicine dances, the chief object of which appears to be the preservation of health. Thus the men of the Nez Perces tribe, between the ages of 18 and 40, assemble annually for the purpose of conquering 'Mawisch,' the spirit of fatigue; the ceremony lasts from three to seven days, and consists in the introduction of willow bougies into the stomach, followed by hot and cold baths and abstinence from food. The Indians are of the firm belief that they secure thereby increased strength and power of endurance (Bancroft), and I see no reason why a perfect cleansing of the body and temporary fasting should not result in a thorough purification of the blood and tissues, a more perfect metabolism and increased nutrition and power of resistance of the individual cells.

The disposal of the dead by cremation, and the destruction of the tepee and personal effects by fire after fatal cases, is a practice in vogue among a number of Indian tribes, and are worthy of mention, as fire is the best known germicide. Many of these primitive peoples appear to have correct ideas as to the communicability of certain diseases. Ehrenreich tells us that consumption prevails extensively among the Karayá in Brazil, and whenever a stranger approaches their huts he is asked whether he suffers from a cough, and unless the answer is negative he is not admitted—a very suggestive precept in view of the fact that scientific medicine has established the infectious character of tuberculosis. Pallas writes that the Kirgise during small-pox epidemics do not hesitate to use their arrows if necessary to keep infected subjects from entering their homes. In passing I may remark that such a brutal system of quarantine was practiced only last year in our country. A man suffering from small-pox was expelled from Arkansas and refused admittance into Mississippi. As he could not remain in or on the Mississippi River until the disease ran its course, he attempted to evade the quarantine and land on the river bank in the latter State, but was shot and killed by one of the quarantine officers.

As an example of public health measures may be mentioned the fact that Harmond, during an expedition to Mé Không, in Farther India, in the land of the Khâs, found, suspended outside of all villages which had been previously visited by cholera, a piece of wood, carved with a sign language to the effect, "Whosoever dares to invade our palisade during the next twelve days will be imprisoned and must pay a fine of four buffaloes and twelve ticals;" the sign on the reverse side gave the number of men, women and children in the village. The same observer noticed that the inhabitants of villages occupied by the Attapeu, which are close neighbors of the tribe of Laotes, laid pieces of lumber in the form of a star across their roads and paths, or suspended similar signs with bunches of leaves with-

out the gates of their settlement, to warn strangers of the prevalence of an epidemic among men or beasts within. The natives of the island of Keisar interdict marriage with lepers, evidently believing that leprosy is not contagious but is transmitted by heredity, while the natives of the Watubela islands believe the converse and transport their lepers to Gorong for isolation and treatment.

The practice of isolating contagious disease, especially during epidemics, appears to be quite common. Thus, at the island of Nias small-pox patients are sent to a temporary shelter outside of the camp and placed in charge of a relative, protected by a previous attack. The Traos of Cochin China, the Tunguse and Burates abandon their small-pox patients after providing them with boiled rice and water. Some of the Indian tribes in northern Mexico also abandon their contagious cases after placing water and wild fruits within easy reach.

But, to return to the Aryan race, we find that the Greeks and Romans, although not, like the Jews, making hygiene a part of their religious duty, paid special attention to the physical culture of their youth, endeavoring, by a rational care of the body, to promote the culture of their mind, and to secure freshness and energy, courage, presence of mind, grace and dignity. "The laws of Lycurgus," says Dr. Gardner, "are not wanting in very pointed enactments on sanitary matters, and the importance attached by all the Greek republics and in the Platonic ideal polity to physical culture is too well known to require further comment;" they paid, also, much attention to the water-supply, constructed numerous aqueducts, and Athens was provided with sewers at an early period of its history.

The teachings of Hippocrates, 400 B. C., doubtless bore many fruits, and whether it is true or not, as stated by Galen, that he ordered, during a pestilence at Athens, aromatic fumigation and large fires in the streets, we have at least his writings on air, water, soil, habitations and occupations and his views of local and seasonal influences on sporadic and epidemic diseases. In Homer's Odyssey reference is made to Ulysses purifying his house with burning sulphur, and Aristotle in his Politica shows his sanitary acumen when he says: "The greatest influence upon health is exerted by those things which we most freely and frequently require for our existence, and this is especially true of water and air."

The Romans, amidst their military operations, found time to construct the 'Cloaca maxima' about 2,400 years ago, which not only served for the removal of refuse, but also helped to drain many of the marshes, and constitutes the principal sewer of modern Rome. Aqueducts were made to cover miles upon miles of the surrounding plains, and their splendid ruins, many of which have been restored and are now used for their original purpose, attest the munificence and abundance with which the first of sanitary requisites was supplied to the Eternal City. At one time Rome had 14 large and 20 small aqueducts, some of which carried the water from a distance of 50 kilometers, and during the reigns of Tiberius and Nero the per capita supply was over 1,400 liters a day. It is stated that between 400 B. C. and 180 A. D. about 800 public baths were established, among them the 'Thermae Caracallæ,' which alone could accommodate 3,000 bathers at one time. It has often been charged, how justly I cannot say, that one of the first things the Christians did in Rome was to try to tear down the baths and convert them into churches; but when we see in our own midst the attempt to convert these useful institutions into abodes of vice, we can imagine how, with a licentious people like the Romans, their baths had degenerated into hotbeds of iniquity.

During the reign of the Cæsars attempts were made to drain the Pontine Marshes, sanitary officials and physicians to the poor were appointed and homes for poor girls and orphans were established. In the meantime the true spirit of Christianity asserted itself, and we read of the establishment of hospitals as early as the 4th century; these were speedily followed by infant and orphan asylums and homes for the poor and incurables. During the Middle Ages sanitation received a decided check, ignorance and brutal prejudices appear to have been the ruling spirit, and for many reasons it was the most insanitary era in history.

About this time most of the towns in Europe were built in a compact form, surrounded with walls; the streets were narrow and often winding for defensive purposes, shutting out light and air from the houses. The accumulation of filth was simply frightful. Stables and houses were close neighbors, human filth was thrown on the streets or manure heap. A city ordinance of Muhlberg in 1367 prescribed that manure deposited by householders on the market space must not be allowed to remain longer than 14 days. The dead were buried within the churchyards. Sewers and aqueducts having been permitted to fall into disuse, the inhabitants were compelled to resort to wells with polluted subsoil water. All the conditions were favorable for the spread of infectious diseases, and in the 14th century the Oriental pest or bubonic plague carried off in Germany over a million victims. Venice lost 100,000 and Florence 50,000 of its inhabitants; England lost one-half of its people, and London, then a city of 110,000 residents, buried over 50,000 in one cemetery. According to conservative estimates the deaths from this plague in Europe amounted to from 25 to 30 million people. The majority of people regarded the plague as the dispensation of God's providence, an evidence of divine wrath, which they hoped to allay by all sorts of self-inflicted punishments, and the passion plays of Oberammergau and elsewhere originated about this time. Others accused the Jews of being the cause, and hundreds were burned at the stake until Pope Urban IV. placed them under his special protection. The Faculty of Paris attributed the epidemic to the conjunction of planets on a certain day in 1345, and the Faculty of Leipzig, with equal gravity, asserted that it was connected with earthquakes, unseen waves of air, inundations, etc. Venice, alone of all Europe, took a sensible view of the matter, and for the first time in history, in 1348, appointed three guardians of public health, and the rules adopted later to isolate infected houses and districts for forty days has given rise to the term quarantine (from quaranta giorni).

We are told that this board rendered excellent service in matters relating to public sanitation, the control of markets and the sale of unwholesome foods, etc., and also inaugurated a system of mortality reports with columns for the insertion of the cause of death, showing that they fully appreciated the importance of vital statistics in the study of the causes and prevention of disease. This question is scarcely understood at the present day, and yet, as remarked by Dr. Billings, "when we wish to study the healthfulness of a city, whether it is getting better or worse, or judge correctly the effects of certain sanitary laws, we should not only know the number of deaths, but also the amount and character of the prevalent diseases, together with accurate information as to the number of population at different ages."

The repeated invasion of the Oriental pest appears to have everywhere compelled some sanitary efforts and an imperial decree in 1426 required the appointment of city

physicians throughout Germany, whose duty it was to adopt preventive measures.

A city ordinance of Nürnberg in 1562 gives detailed directions as to the quality of bread, beer and wine offered for sale, the cleaning of streets and houses, the disposition of infected clothing and bedding, the fumigation with sulphur and straw of pest-houses, etc.

In 1685 Prussia established a Central Medical Bureau, and appointments of health officers and privy medical counsellors were made, whose duties consisted in advising the men entrusted with the care of the government on matters relating to public health, and some of these titles are still in vogue in Europe. About the same time sanitary improvements in the way of widening streets for the purpose of supplying more air and light to the habitations, and better methods for the collection and removal of the wastes of human life were introduced, but, broadly speaking, at the close of the 17th century the habits of the people in Europe were generally filthy and in striking contrast to those observed among the most untutored savages of the present day.

In Madrid, we are told, that not even a privy existed in 1760. It was customary to throw the ordure out of the windows at night, and it was removed by scavengers the next day. An ordinance having been issued by the king that every householder should build a privy, the people violently opposed it as an arbitrary proceeding, and the physicians remonstrated against it, alleging that the filth absorbed the unwholesome particles of the air which otherwise would be taken into the human body. His majesty, however, with commendable zeal, persisted, but many of his citizens, in order to keep their food wholesome, erected privies close to their kitchen fireplaces.

With such unsanitary conditions we need be surprised that the mortality in towns was greater than their birth-rate and that the city population had to be recruited continually from the country, conditions which existed until the beginning of the present century. Professor Finklenburg, of Bonn, estimates that the average human life in the 16th century was only 18 to 20 years, while to-day it is over 40 years.

The mortality of London between 1660 and 1679 was 50 per 1,000 of inhabitants; from 1679 to 1728, including the period of pests, it was 80 per 1,000; between 1728 and 1780 it was still 40 per 1,000, while at the present time it is between 20 and 21 per 1,000, and the mean annual death-rate in England is less than 19 per 1,000. Without underestimating the brilliant achievements of Jenner's discovery of vaccination in 1796, which as a preventive measure has saved millions of lives, no two factors have contributed so much to the general result than the improvement of the air we breathe and the water we drink. Indeed, we have ample evidence that, with the introduction of sewers and public water supplies, the general mortality in numerous cities, during the past forty years, has been reduced fully one-half, the good effects being especially shown by a marked decrease in the number of cases of typhoid fever, diarrhœal diseases and consumption. The vital statistics of Great Britain furnish the proof. The mortality of Salisbury within the last 30 years has been reduced from 40 to 16 per 1,000; at Dover from 28 to 14 per 1,000; at Rugby from 24 to 10 per 1,000; at Croydon from 28 to 15 per 1,000 and at Matlock from 18 to 9 per 1,000.

		Enteric Fever.	Diarrhœa.	Consumpt'n.
Bristol,	before sanitary works	10.0	10.5	31.0
"	after " "	6.5	9.1	25.5
Leicester,	before " "	14.7	16.0	43.3
"	after " "	7.7	19.3	29.3
Cardiff,	before " "	17.5	17.2	34.7
"	after " "	10.5	4.5	28.6
Mucclesfield,	before " "	14.2	11.0	51.5
"	after " "	8.5	9.0	35.3
Warwick,	before " "	19.0	5.7	40.0
"	after " "	9.0	8.0	32.3

Stratford,	before sanitary works			12.5	11.2	26.6
"	after	"	"	4.0	5.7	26.5
Ashby,	before	"	"	13.3	4.0	25.5
"	after	"	"	5.7	8.3	31.3
Dover,	before	"	"	14.0	9.5	26.5
"	after	"	"	9.0	7.0	21.2
Croydon,	before	"	"	15.0	10.0	——
"	after	"	"	5.5	7.0	——

Now let us see what a pure water supply has accomplished. A summary of the evidence on this subject reveals the significant fact that cities, both at home and abroad, in which there has been the most marked decrease in the typhoid-fever death-rate, are those in which a pure supply has been substituted for a pre-existing contaminated one. Thus, for example, the typhoid-fever death-rate in Boston in 1846–1849 was still 17.4 per 10,000; in 1890–1892 it had fallen to 3.2 per 10,000, the city having in the meantime expended $25,000,000 on its water supply. The rate from this disease in Lawrence, Mass., for five years prior to 1893 was 12.7 per 10,000. After the establishment of sand filters, in September, 1893, the rate fell during the first twelve months to 5.2 per 10,000. In other words, 48 human lives at a value of $5,000 each, or a total value of $220,000, were saved to that city by an expenditure of only $65,000 for the plant and $4,000 running expenses per year. The typhoid-fever death-rate in Chicago in 1892 was 14.3 per 10,000. After improving the water supply it fell to 5.6 per 10,000. In 1874 the rate in Vienna was 11.5 per 10,000, and, with the introduction of a pure water supply, it has fallen to less than 2 per 10,000. The experience of London, Berlin, Munich and a host of other cities has been precisely the same.

Munich was notorious for its excessive typhoid-fever death-rate, it being 29 per 10,000 in 1856. With the introduction of a pure water supply and improved sewer system it has fallen to less than 2 per 10,000.

The question has passed beyond the speculative or experimental stage. Conservative cities are not in the habit of authorizing the expenditure of large sums of money without counting the cost and results; and the mortality statistics have furnished more eloquent and conclusive arguments than the most zealous advocates of sanitary reforms.

An abundance of water does not limit the spread of typhoid fever, for New York City, with only 78 gallons per head a day, has only 2.3 deaths; while this city, with a daily per capita consumption of 173 gallons, furnishes 8.12 deaths, and stands to-day No. 7 on the list of 54 American cities as regards an excessive death-rate from typhoid fever, only Denver, Allegheny, Camden, Pittsburg, Newark and Charleston furnish a higher rate.

Let us advocate, therefore, an ample quantity of pure water, and until this is accomplished let us filter and boil our drinking water, boil our milk, and thoroughly disinfect the excreta of typhoid-fever patients. The present century can boast therefore, of many advances in hygiene, particularly since the European invasion of cholera in 1830. The English towns and cities which had been visited by this disease and those fearing similar scourges were perfectly willing to profit by the investigations of the causes of infectious diseases and freely instituted sanitary reforms in the establishment of sewers, public water supplies, sanitary homes, etc. The example of England was followed by all civilized nations, with similar results. The effects of sanitation, as taught by Dr. Parkes, were demonstrated during the Crimean War and, as beautifully expressed by Virchow during our Civil War, reached 'the highest point in humane efforts ever attained in a great war.'

A study of the causes of infectious diseases also suggested more enlightened means for their prevention or mitigation, as the compulsory vaccination against small-pox, compulsory isolation and disin-

fection in a number of infectious diseases, the prevention of soil and water pollution for the restriction of typhoid fever, cholera, dysentery and other water-borne diseases, and, finally, the labors of Pasteur, Koch, and Sternberg of our country, in the identification and destruction of disease germs, have accomplished a great deal and opened a field of preventive inoculations which promises other practical results. The medical profession speaks of preventable diseases, and the Prince of Wales, in his opening address at the International Congress of Hygiene, held in London in 1891, very properly said: "If certain diseases are preventable, why are they not prevented?" The facts are that whilst the scientific physician knows fully well that if, for example, the dejecta of every typhoid-fever patient were promptly disinfected with germicides, typhoid fever would be stamped out in the course of a few years, he is not in a position to enforce this opinion by effective laws.

To illustrate what germicides and antiseptic methods have accomplished, let me remind you that the mortality from all amputations in the Crimean War (1854–55) was 63.5 per cent., in our Civil War it was still 48.7 per cent., but this percentage has steadily fallen until, in 1890, it was only 6.9 per cent. A century ago the mortality from puerperal fever at the lying-in department of the Hotel Dieu in Paris amounted to 10%. Semmelweis, in 1847, first insisted upon compulsory antiseptic midwifery, and since that time the mortality has fallen in all well-regulated maternities to less than one per cent. Witness, also, the advances made in the construction of model hospitals, asylums, schools, prisons and industrial establishments in relation to light, heating, ventilation, etc.

At the close of the last century the mortality among the inmates of French prisons was 250 *pro mille;* in the German prisons, in the forties, it was between 34 and 60 per 1,000, while in 1878 to 1882 it had fallen to 27 per 1,000.

In the matter of personal hygiene much has been done in the way of improved dietetics, clothing, exercise, and especially in the care and feeding of infants, but much remains to be done.

I will not weary you with a recital of what other countries have accomplished in the way of national and local health boards, enactment of health laws, the enforcement of sanitary police regulations, laws for the suppression of quackery and quack remedies, all of which have contributed greatly to the sum-total in the field of public sanitation.

While the people of the United States were not slow in adopting and originating sanitary measures of great value, our ideas of personal liberty, guaranteed to us by the Constitution, evidently prevented early legislation in matters of public health, except in matters of State quarantine, for fear that such legislation might affect the personal habits of the citizen and lessen his freedom of action. At all events, the first State Board of Health was established in Massachusetts only in 1869, since which time nearly all of the other States have followed her example. In 1872 the American Public Health Association was organized, and numbering, as it does, among its members some of the best minds in the profession, much good has been accomplished by this body and the so-called 'sanitary conventions' in molding public opinion and in framing and recommending health laws.

Measures for the control and restriction of contagious diseases have been adopted by most of the Health Boards, and a number of States enforce compulsory vaccination for school children, and have passed laws regulating the sale of poisons, and for the prevention of food and drug adulterations, and the extermination of bovine tubercu-

losis. In 1879 Congress created a National Board of Health, whose duty it was to make investigations into the causes and means of prevention of contagious and infectious diseases, to indicate measures of national importance and to be a center of information for all matters relating to public health. For want of appropriation this important body has ceased to exist, and since 1883 the duties relating to international and interstate quarantine have been discharged by the Surgeon-General of the Marine Hospital Service; his bureau, apart from the management of hospitals and stations for the care of sick and disabled seamen of the merchant marine, has also undertaken the collection and dissemination of mortality statistics and sanitary information, scientific investigation into the causes of disease, the physical examination of immigrants under the law excluding those affected with contagious disease—service in the office of consuls at foreign ports to assure the accuracy of bills of health—and other miscellaneous duties. Since Congress has failed to act upon the President's repeated recommendation and the petition of numerous medical societies for the creation of a National Health establishment, there is no good reason why the scope of duties and powers exercised by the Marine Hospital Service should not be enlarged.

An advisory board, composed of one representative from the various State Boards of Health, the chiefs of the medical department of the army and navy, and of the Bureau of Animal Industry, Census and Weather Bureau, and one of the legal officers of the government, could meet once or twice a year and decide upon a line of work for the promotion of public health.

One of the most pressing needs is an investigation into the pollution of water-supplies when such pollution affects or threatens to affect the sanitary condition of the people of more than one State, because the individual States are powerless to protect themselves against the misdeeds of their neighbors. Mr. Barthold's bill for the appointment of a River Pollution Commission, two years ago, was defeated; yet that same Congress appropriated $40,000 for the extermination of the Gipsy moth. England enjoyed the benefit of such a commission as early as 1855, and, in order to prevent, remedy and remove the danger of polluted water-supplies, adopted a comprehensive system for the disposal of sewage and of water filtration, the fruits of which have already been referred to.

We know that the Potomac River receives the drainage from every town and hamlet washed by its shores and tributaries, and what is true of the Potomac is equally true of the Ohio, Mississippi, Merrimac, Connecticut, Missouri, the Red River, the Columbia and Wabash Rivers, which are the sewers and, at the same time, the source of water supply for nearly all the cities located upon its banks, and these cities, as shown by the statistics collected by the Marine Hospital Service, show moreover a marked prevalence of typhoid fever, confirming what has elsewhere been proved, that this disease, as also cholera, dysentery and diarrhœal diseases, can be carried from one town or city to another by means of a water course.

Surgeon-General Wyman in a recent contribution estimates, from statistics received in his office, that every year there are no fewer than 45,000 deaths caused by typhoid fever alone throughout the United States, and, based upon an estimated mortality of 10%, it is within reason to assume a yearly prevalence of 450,000 cases of this disease. The average duration of a case of typhoid fever is not less than 30 days. If we calculate that an average of $1.00 is expended per day for care, treatment and loss of work, and that the value of a human life is $5,000 each, we have a total loss in

the United States of $238,500,000 per annum from one of the so-called preventable diseases. Reduce the prevalence of this single disease one-half, which has been accomplished in England, and the oft-recurring question: "How is it our fathers got along without these so-called modern improvements?" will be satisfactorily answered from an economic point of view.

Another subject which deserves special attention is the question of pure foods and drugs. It would lead me entirely too far even to touch upon all the gross frauds and their serious consequences which are daily perpetrated, but permit me to refer to a very universal article of food, viz., milk. Analyses of milk sold in New York City showed an average dilution with 33% of water, the fraud amounting to $10,000 per day. The State Inspector found 12% of water added and 20% of cream removed. The results in St. Louis, Chicago and this and every other city are similar, and indicate the desirability of stringent laws governing the milk traffic as a protection to the pocket of the consumer; but when we remember that Dr. Busey and the writer have collected and tabulated 138 epidemics of typhoid fever, 74 of scarlet fever and 28 epidemics of diphtheria, and that an analysis of the evidence showed that the poison of these diseases may reach the milk by soakage of the germs into the well water with which the utensils are washed, or by the intentional dilution with infected water; that the infection can be conveyed by animals wading in sewage-polluted water, or by the dairy employes acting as nurses, or suffering themselves from some mild infection while continuing their usual duties, or are convalescent from the disease; and that infection has taken place through the agency of scrubbing brushes, flies and other insects, exposure of the milk in or near to the sick rooms, or washing the patients with the same cloth used in wiping the dairy utensils, we see at once that dairies should be under sanitary control to prevent the propagation of disease by infected milk. This should include inspection of the dairy stock by competent veterinarians, so that the milk of animals suffering from bovine tuberculosis, erysipelas, anthrax, pleuro-pneumonia, foot and mouth disease, septic and other fevers, specific enteritis, rabies, tetanus, garget and other inflammatory conditions of the teats and udder may be excluded from the supply. Milk may also be rendered unfit for use by reason of improper food and care of the animal, or while the animal is being treated with powerful remedial agents. It is interesting to note that of the 240 milk epidemics collected by us, 187 were reported by English, 31 by American and 9 by Scandinavian observers; 8 came from German, 3 from Australian, and 1 each from French and Swiss sources. And right here it is suggested that the infrequency of milk-typhoid in France and Germany is due to the fact that milk is rarely used in its raw state on the Continent of Europe, and the germs are destroyed by sterilization.

The first movement towards securing comprehensive legislation against the adulteration of foods and drugs in this country was made in 1879. This is all the more surprising because Dr. Mann in his Medical Sketches of 1812 remarks that "the bread on the Niagara was made of damaged flour, such as was either not nutritious or absolutely deleterious." It was believed also that the flour contained in some instances an earthy substance, and that this adulterating substance was 'plaster of paris.' Again, during the Civil War, as early as in the winter of 1861–62, an extract of coffee furnished the troops in the vicinity of Alexandria produced nausea and vomiting in those who used it, and subsequently a government contractor, for having practiced

food adulterations, was sentenced to a protracted imprisonment.

Instances, therefore, were not wanting pointing to the necessity of such laws; nevertheless, it was not until 1881 that three States, New Jersey, New York and Michigan, passed laws to prevent the adulteration of food and drugs. The law in New York commenced in the summer of 1882. At the close of the year 286 samples of food and drugs had been submitted to the public analysist for examination, of which 194 had been reported upon. Of 119 samples of food, 50 were found adulterated; while of 75 samples of drugs, 32 were adulterated.

Since 1883 quite a number of States have enacted similar laws, but I regret to say that in spite of the absolute necessity for such a law in this city, as revealed by the report of the chemist of the Health Office, the bill introduced during the last session of Congress failed to become a law. The majority of States have enacted laws to regulate the sale of poisons, but a careful study shows that they should be amended and greater restriction placed on the sale of poisons generally. A recent investigation, by a committee of the Medical and Surgical Society, into the extent of the opium habit in the District of Columbia, reveals the fact that during the past 10 years 7 persons died from the opium habit, 36 persons died from accidental or negligent opium poisoning, and 125 cases of opium poisoning and 70 patients were treated for the opium habit in our public hospitals. This does not include persons treated for acute or chronic opium poisoning in private practice. Investigation into the causes of the opium habit led to the conclusion that one class of subjects have contracted the habit by the use of the milder preparations of opium, and some of the various proprietary or secret remedies commonly employed as domestic remedies, such as paregoric, McMunn's elixir, diarrhœa mixtures, pain-killers, etc. Another class have evidently acquired the habit by the constant use of prescriptions containing opium or its preparations for the relief of pain, the individuals being at first quite unconscious of the enslaving nature of the drug. Still another class of persons belong to the moral degenerates of fast men and women, who have acquired the habit by contact with opium habitués including opium smokers, and through solicitation, invitation and persuasion have fallen victims to the vice.

Since the opium habit is often established by the unauthorized and indiscriminate renewal of prescriptions containing opiates, the New York Legislature very wisely enacted, in 1886, a law that no pharmacists shall refill more than once prescriptions containing opium or morphine, or preparations of either, in which the dose of opium shall exceed $\frac{1}{4}$ grain, or morphine $\frac{1}{20}$ grain, except with the verbal or written order of a physician. A similar bill was introduced into Congress during the winter session, but failed to become a law. This city is also without a law for the suppression of the opium joints, in spite of the fact that a man died a few months ago from the effects of opium smoking in one of the joints, of which there are two; and a conservative estimate places the number of habitual opium smokers in the city between 150 and 200.

It is clearly the duty of the State to close opium dens and restrict the sale of poisons, and in regard to the sale of patent and proprietary medicines containing poisonous drugs the contents should be expressed on the label and the word poison added.

At the risk of taxing your patience, permit me to refer to the subject of patent and proprietary medicines.

By the term patent medicine, as properly employed in this country, England and Europe generally, it must be understood

that the composition is known and can be seen at the Patent Office. The proprietary medicine is a secret preparation protected by a trade mark in this country, and hence preferred by the owner, but both are vaguely termed by the public patent medicines.

The extent of the traffic will be apparent when I tell you that up to December 31, 1896, the United States Patent Office had issued patents on the following:

Disinfectants	235
Extracts	226
Hair dyes and tonics	43
Insecticides	145
Internal remedies	356
Plasters	48
Topical remedies	351
Veterinary remedies	75
TRADE MARKS.	
Drugs and chemicals	614
Medical compounds	4979

The proprietary medicines are subect to the control of the State authorities, and if containing alcohol in sufficient quantity to be intoxicants are subject to Internal Revenue Laws, but so far as my knowledge extends little or nothing has been done in this country and in England to control the sale of secret remedies. Dr. G. Danford Thomas, Coroner of London and Middlesex, before the International Congress of Hygiene in 1891, very justly urged that all proprietary medicines should be under the Patent Laws, because the composition is at least disclosed; he would abolish licences to sell them and confine the sale to chemists and druggists only. In these matters we could certainly profit by the example of the Japanese, Italian, French and German laws. The Japanese government has established a public laboratory for the analysis of chemicals and patent medicines. The proprietors are bound to supply a sample with the names and proportions of the ingredients, directions for its use and an explanation of the supposed efficacy. During the year 1889 there were no fewer than 11,904 applicants for licenses to prepare and sell 148,091 patent and secret medicines. Permission for the sale of 58,638 different kinds was granted; 8,592 were prohibited; 9,918 were ordered to be discountenanced, and 70,943 remained still to be reported on. The majority of those authorized to be sold were of no efficacy, and but few were really remedial agents. The sale of these was not prohibited, as they were not dangerous to the health of the people. No objection can be urged to this law from a sanitary point of view, except that it continues to protect the 'pseudo-scientist.'

In Italy (which country, by the way, has the best national board of health) the sale of secret remedies in January, 1891, became subject to the following regulations: The composition as to the quality and quantity of the active substances contained must be written on the labels and on the advertisements; no special therapeutic virtue or indication shall be attributed to them either on the label or advertisement; they shall be sold only by chemists under the vigilance of the sanitary authorities and with medical prescriptions.

In France the pharmacier is forbidden to sell secret remedies or even to keep them on his premises under heavy penalties.

In Germany the chemist may sell patent medicines when ordered by the prescription of the physician. He must not sell secret remedies. All patent medicines sold by the chemist must be prepared under special supervision and according to the rules of the pharmacopœa.

From the foregoing we may conclude that, while a good deal has been accomplished by public and private sanitation, much remains to be done before the average length of human life reaches threescore and ten.

GEORGE M. KOBER.

GEORGETOWN UNIVERSITY.

CONTRIBUTIONS TO OUR KNOWLEDGE OF MICRO-ORGANISMS AND STERILIZING PROCESSES IN THE CANNING INDUSTRIES.

In a paper read before the Society of Arts in October, 1896,* we showed the extent of the canning industry in this country, and the importance to it of accurate knowledge of the bacteriological principles of sterilization. In that paper we dealt with the packing of clams and lobsters, and described some of the bacteria which are active in the deterioration of these products in case sterilization is not complete. It is interesting to notice that some of the results which we published at that time have lately been confirmed by a specialist employed by the Canadian government† to investigate the discoloration of canned lobsters.

We now desire to put on record a preliminary account of our more recent investigations in another branch of the industry, viz., the packing of sweet corn. This art constitutes a very large industry, as is shown by the fact that in 1895 72,000,000 two-pound cans (72,000 tons) were packed in the United States. The growth of the business has been rapid, for it was not until about 1853 that corn was packed at all with success.

Sweet corn, when properly prepared, is one of the most valuable of all canned foods, as it retains much of its original flavor, is popular, and is sold at a price within the reach of all. If, however, the sterilizing has not been thoroughly done there may result fermentations caused by bacteria which have not been killed, producing what is known as 'sour' corn.

Our investigations commenced in February, 1897, with the examination of a large number of cans of sour corn. On opening the cans no change was noticeable to the eye, the corn appearing fresh and of a natural color. In some cases a sour odor could be detected, but in others this was not observed. It was to the taste that the trouble was most apparent, the corn being sour and of a peculiar, astringent flavor. Bacteriological examinations showed sound cans to be sterile, while spoiled cans invariably gave evidence of bacterial action. Pure cultures of six species were obtained, of which five were bacilli, and one was a micrococcus. By inoculating sterile cans of corn with these organisms we have been able to produce souring in all respects similar to that of the spoiled cans from which they were originally taken.

In order to study these fermentations more thoroughly and to ascertain, if possible, the source of the bacteria causing them, we spent nearly the whole of the corn-packing season of 1897 at an establishment in Oxford county, Maine, where every convenience for scientific study of the process was put at our disposal by the proprietors. We were thus enabled to thoroughly investigate the methods of procedure from the harvesting of the green corn to its ultimate shipment in cans. It is very necessary that the utmost cleanliness and dispatch should be observed in all the operations, so that the chances of infection from bacteria may be reduced to a minimum. In this factory the strictest caution was exercised in these respects, everything being kept scrupulously clean.

The corn is generally picked in the morning, and is delivered to the cannery as early as possible. One or two men make it their special duty to visit the farms once or twice a week during the season to keep informed as to the condition of the crop and to 'order in' the corn as it becomes sufficiently matured. As the ears are delivered at the factory they are arranged in low piles on the ground in an open shed to protect them from the sun. The husks and the silk are

* Technology Quarterly, Vol. X., No. 1.

† Supplement No. 2, 29th Annual Rep't, Department of Marine and Fisheries, Ottawa, 1897.

taken off by hand, and the corn is then quickly carried to the cutting machines, in which, by a series of knives and scrapers, the kernels are quickly and cleanly separated from the cob. Any stray bits of cob or silk which may be mixed with the corn are now taken out as it passes through the 'silker,' a machine arranged somewhat on the plan of a gravel-sifter, that is, with two cylindrical wire screens one inside the other, placed on an incline and rotating in opposite directions. The corn drops through the meshes of the screens, while the refuse passes out at the lower (open) end.

The corn is now weighed, mixed with water in the proper proportions, and is then ready for the 'cooker.' There are several varieties of these machines in use, all of which are alike in principle but differ somewhat in details of construction. Their object is to heat the corn evenly and quickly to a temperature of 82–88° C. (180–190°F.) and to deliver it automatically into the cans. A single machine fills about thirty cans a minute. After having been wiped, the cans are capped, soldered and tested for leaks. Sterilization, the final and most important step in the whole process, now follows, this being done in retorts, by steam under pressure. The length of heating, or 'processing,' and the pressure which is given vary somewhat in different factories.

As we have shown in our previous paper, in order to insure sterilization in practice, it is necessary to obtain and maintain a temperature in excess of 100° C. (212° F.) throughout the contents of the can. Intermittent sterilization may be employed, but is less efficient and is not practicable upon a large or commercial scale. We have found by experiment that sixty minutes at 121° C. (250° F.) is sufficient time for sterilizing corn, and it seems probable that this can be shortened somewhat or the temperature reduced. Further experiments are in progress to decide this question.

Through a demand that canned corn shall be very light in color there has been, apparently, a pressure put upon the packer to shorten the time of heating or to reduce the temperature in his retorts. The large losses which have resulted in recent years from sour corn have been due principally to this demand. By the use of registering thermometers we have proved that corn is a very poor conductor of heat, and that the time necessary to bring all portions of the center of the cans to the requisite temperature is a factor whose importance cannot be overestimated. We have proved by experiment that, with 13 pounds of steam in the retort, the corresponding temperature of which is 118.8° C. (246° F.), it requires 55 minutes for the same temperature to be registered at the center of a can placed in the middle of a retortful of corn. With the same pressure and under the same conditions at the end of 45 minutes a temperature of 114° C. (237.2° F.) was reached, and at the end of 30 minutes 108.3° C. (227° F.). Thus it is evident that with the present methods any reduction of time of heating is attended by considerable risk. If any means could be devised by which the heat would more quickly reach the center of the cans it might be safe to shorten the time of heating. There is a prospect that before long some such modifications may be possible.

We have made a careful bacteriological study of all the different steps in the process and of the corn as it comes from the field, and have found upon the corn in the field bacteria which appear to be identical with those isolated from cans of sour corn. Repeated tests of corn from the cob showed the presence of bacteria. Corn which had passed through the cooker, and cans of corn which had been 'retorted' for 30 minutes or less, also contained the same species of bacteria as were found upon the raw corn.

All these bacteria liquify gelatin, and

grow very rapidly, as is proved by the fact that streak cultures showed well marked growth four hours after inoculation. Detailed descriptions of the organisms and of many more experiments will be given in our full paper on this subject to appear in a forthcoming number of the *Technology Quarterly.*

S. C. Prescott,
W. Lyman Underwood.
Biological Laboratory, Mass. Institute of Technology.
Boston, November 12, 1897.

AMERICAN ORNITHOLOGISTS' UNION.

The Fifteenth Congress of the American Ornithologists' Union convened in New York City, Monday evening, November 8th. The public sessions, lasting three days, were held in the library of the American Museum of Natural History.

William Brewster, of Cambridge, Mass., was re-elected President; Dr. C. Hart Merriam and Robert Ridgway, of Washington, D. C., Vice Presidents; John H. Sage, of Portland, Conn., Secretary; William Dutcher, of New York City, Treasurer; Charles F. Batchelder, Frank M. Chapman, Chas. B. Cory, Ruthven Deane, Drs. Jonathan Dwight, Jr., A. K. Fisher and L. Stejneger, members of the Council. By a provision of the by-laws, the ex-Presidents of the Union, Dr. J. A. Allen, Dr. Elliott Coues, and Mr. D. G. Elliot, are *ex officio* members of the Council.

One active and eighty-eight associate members were elected. As a direct result of the Audubon Society movement, creating a popular interest in the study of birds, more women than usual were elected to associate membership.

An address in commemoration of Major Charles Emil Bendire, U. S. A., a distinguished member of the Union who died during the past year, was prepared by Dr. J. C. Merrill, U. S. A., and presented by Mr. Elliot. Major Bendire was a well-known oologist, and will always be remembered by his invaluable 'Life Histories of North American Birds.'

Dr. Coues exhibited the portfolio carried by John James Audubon in Europe and America, and also the original MS. of the first volume of his 'Ornithological Biography.' Some original bird-drawings by John Woodhouse Audubon were also shown.

Mr. Abbott H. Thayer, the eminent portrait painter, gave an out-of-door demonstration of the underlying principle of protective coloration, in continuation of his remarks on the subject at the previous meeting. Mr. Thayer showed a pair of decoys with the belly part cut off, so that in lying on the cut-off side they represented crouching birds or mammals. He then repeated upon them the coloring which he had exhibited at Cambridge upon entire decoys (decoys poised a few inches above the ground). This, he said, was to more clearly illustrate what he stated in his first paper on protective coloration, namely, that the normal gradation of sky's lighting is effaced *by the color gradation of the animal at every point*, the median dorsal line having the darkest markings, so that the gradation toward the white of the belly *begins close to this dorsal line.* Mr. Thayer placed the two decoys side by side on a plank, and covered one of them uniformly with the same dry earth which he spread about it on the plank, so that all of its visible surface and that of the plank on which it lay were absolutely of one tint—monochrome; yet it was conspicuously visible at a long distance, because of its normal gradation of shading from the sky's light, although there was no underside visible to show a culmination of shadow. The other decoy he painted in imitation of a hare's or snipe's gradation and so successfully that it became totally invisible at a distance of four or five yards. He explained that the statement in his first paper

that not a feather of the upper surfaces of the woodcock and grouse had been artificially colored referred only to the feathers along the median dorsal region.

The skin of a cottontail rabbit was exhibited, showing a most perfect gradation from the black hairs of the middle of the back and over the shoulders to the white of the belly.

This communication, in connection with that given at Cambridge a year ago, completes Mr. Thayer's admirable demonstration of his theory of the great underlying principle of protective coloration in animals.

On Wednesday evening, November 10th, an illustrated lecture entitled 'A Naturalist's Expedition to East Africa,' was given in the large lecture hall of the Museum by Mr. D. G. Elliot before an audience of some 1,500 persons.

Mr. Wm. Dutcher, Chairman of the 'Committee on Protection of North American Birds,' read a most interesting report on the work done during the past year. This report will be published in abstract in *The Auk*, and printed in full as a separate pamphlet.

Mr. Frank M. Chapman gave an exhibition of lantern slides of birds in nature, from material contributed by himself and other members of the Union. This was followed by Professor A. S. Bickmore with colored lantern slides showing recent advances in methods of visual instruction.

Dr. Coues remarked upon certain *Laridæ* which were before him, and Dr. Jonathan Dwight, Jr., showed a specimen of a new species of bird for North America (*Puffinus assimilis*).

An informal talk on the Gyrfalcons was given by Mr. Chapman, who exhibited specimens from Greenland and Labrador. Remarks followed by Dr. W. E. Hughes, who accompanied the first Peary expedition to north Greenland.

Following is a list of the papers read at the sessions, in addition to those already mentioned:

Protective Adaptations of Insects from an Ornithological Point of View: SYLVESTER D. JUDD.

Summer Birds of the West Virginia Spruce Belt: WILLIAM C. RIVES.

Is Uniformity in Local Lists Possible? JONATHAN DWIGHT, JR.

Ten Days among the Birds of Northern New Hampshire: JOHN N. CLARK.

Some Notes on Liberian Birds: HARRY C. OBERHOLSER.

Remarks on a New Theory of the Origin of Bird Migration: J. A. ALLEN.

Experiences of an Ornithologist in Mexico: FRANK M. CHAPMAN.

The Great Roosts on Gabberet Island, Opposite North St. Louis: O. WIDMANN.

The Terns of Gull Island, N. Y.: J. HARRIS REED.

The Petrels of Southern California: A. W. ANTHONY.

The Terns of Muskeget Island, Mass.: GEORGE H. MACKAY.

The Northern Raven Breeding in New England: H. K. JOB.

The Summer Birds of the Catskill Mountains, with remarks upon the Faunæ of the Region: EDWIN I. HAINES.

Breeding Habits of the Common Robin in Eastern Massachusetts: REGINALD WEBER HOWE, JR.

The next meeting of the Union will be held in Washington, D. C., commencing November 14, 1898. JNO. H. SAGE,
Secretary.

CURRENT NOTES ON ANTHROPOLOGY.

THE ABORIGINAL ART OF ECUADOR.

THE well known Alpine explorer, Mr. Edward Whymper, during his expedition to the Andes made a considerable ethnographical collection in and near Ecuador, a description of which, with illustrations, is given by Mr. O. M. Dalton in the *Journal* of the Anthropological Institute for August.

The most interesting results refer to the forms of axes and similar stone implements. There are numerous types in Ecuador, many seemingly indigenous, while almost all the Colombian forms 'can easily be traced to a foreign source.' There are frequent instances of resemblance between

types common to the Antilles and Ecuador, and these resemblances are most abundant in the islands most accessible to the South American continent. It is also noted that one quite peculiar form of stone axe, with a depression at the butt and rounded lateral arms, which seems to have reached its perfected development in Ecuador, has been discovered also, both in stone and copper, in tombs of the IVth and XIIth dynasties of Egypt; another illustration of the parallelism of artistic development. The pottery of Ecuador, as shown in the collection, is closely assimilated to that of Chiriqui and other parts of Central America.

THE BERBERS OF MOROCCO.

The most accurate description of this people since that of Quedlinberg is given by Mr. W. B. Harris in the *Journal* of the Anthropological Institute for August. He notes their complexion as nearly always fair, while many are red-haired, red-bearded, and with blue eyes. The Susis, however, south of the Atlas, and claiming to be of unadulterated Berber blood, are copper-colored, with high cheek bones and narrow dark eyes. This would seem to bear out Dr. Collignon's theory of a dark and light Berber type. The Riffians are distinguished by a 'scalp-lock,' which they allow to grow thick and long. It is plaited or twisted, and wound around the head. Mr. Harris does not explain its significance. In the central Atlas they still call themselves 'Berber' (plural Berebber), but the meaning of the term was not obtained.

They apparently have no knowledge of the old Hamitic or modern Tuareg alphabet, and he asserts that no writing in their tongue exists, though it is occasionally written in Arabic characters. Many tracts of the Riff country of the north have never been visited by Europeans, and the Sultan of Morocco exerts a merely nominal control over it. D. G. Brinton.

University of Pennsylvania.

NOTES ON INORGANIC CHEMISTRY.

A contribution to the much discussed subject of the use of alum in foods is given in the last *Journal* of the American Chemical Society, by Professor C. F. Mabery and L. Goldsmith. The authors describe a series of tests as to the influence of varying quantities of alum on the peptic digestion of blood fibrin. In every case the digestive action was retarded by alum, even when present in very small quantity. In order to test the action under actual conditions, two loaves of bread were prepared, one with alum baking powder and the other with a cream-of-tartar-soda powder. Here, again, the peptic digestion was retarded in the case of the bread containing alum. Similar experiments carried out with salicylic acid, boric acid and with formalin showed that while there was with these antiseptics some retardation of the peptic digestion it was slight in comparison with that when alum was used.

The cause of the rusting of iron which is covered with a protective layer of paint is usually attributed to minute cracks in the paint, occasioned by the unequal expansion of the iron and paint. Edmund Simon gives in *Dingler's Polytechnisches Journal* the results of a study of the conditions of this rusting, and concludes that paint stands changes in temperature, but is always hygroscopic, and when swollen by moisture is pervious both for water and gases. The best way to prevent such rusting is to use three or four coats of a paint, which adheres as closely as possible to the iron, and which contains the largest possible quantity of oil.

In the *Zeitschrift für physikalische Chemie* John Gibson contends that in all cases the chemical action of light is such that the new products have a higher conductivity than the original. This is true in the case of selenium, sulfur, phosphorous and mercuric sulfid, in the combination of hy-

drogen and chlorin, and in the reduction of silver and mercury salts. The action of light on nitric acid seems to be the only exception, but this is only an apparent exception, as the conductivity of nitric acid solution increases up to 32 per cent. when the maximum is reached, whilst the decomposition by light ceases when the concentration has fallen to 47 per cent.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE anniversary meeting of the Royal Society will be held on Tuesday, November 30th, when the officers for the ensuing year will be elected. Lord Lister will be recommended for re-election as President.

THE new house of the American Society of Civil Engineers, 220 West Fifty-seventh street, erected at a cost of $200,000, was formally opened on November 24th. Addresses were made in the new auditorium in the afternoon by the President of the Society, Mr. B. M. Harrod, of New Orleans, and there was a reception in the evening.

THE Danish Geographical Society has awarded its gold medal to Dr. Sven Hedin.

DR. GUIDO SCHNEIDER has been appointed Director of the Biological Institute recently established at Sebastopol.

THE death is announced of Professor Henry Calderwood, since 1868 professor of moral philosophy in the University of Edinburgh, on November 20th, at the age of sixty-seven years. He was the author of numerous publications on education and philosophy, among the more important of which were the 'Relations of Science and Religion' (1881) and the 'Relations of Mind and Brain' (1879), the latter being one of the first systematic treatises on physiological psychology.

THE *Athenæum*, in announcing the death, on November 1st, of the Rev. Peter Bellinger Brodie, of Rowington, in Warwickshire, at the age of 82, states that while a student at Cambridge, Mr. Brodie, like so many others, acquired an enthusiastic love for geology, under the teaching of Professor Sedgwick. His name soon came to be identified with the study of fossil insects, and in 1845 he published a work on this subject. Mr. Brodie was elected a Fellow of the Geological Society as far back as 1834; and the Society recognized the value of his work by the award, in 1887, of the Murchison Medal. A selection from Mr. Brodie's extensive geological collections was acquired a short time ago by the British Museum.

WE regret also to record the following deaths among foreign men of science: Dr. G. H. Otto Vogler, aged seventy-five, a versatile writer on natural history; Dr. Johannes Frentzel, Director of the Biological Station on the Müggelsee, near Berlin, aged 38 years; Dr. L. A. Buchner, professor of pharmacology at Munich, aged eighty-four years; Professor Karl Müller, Director of the Experiment Station for Agricultural Chemistry at Hildesheim, and of Dr. Fr. Stohman, honorary professor of agricultural chemistry at Leipzig, aged sixty-five years.

THE report of the Commissioner of Patents upon the business of the Patent Office for the fiscal year ended June 30, 1897, shows that there were received within that year 43,524 applications for patents, of which 23,994 were granted, including reissues and designs. The number of patents which expired was 12,584. The number of allowed applications which were by operation of law forfeited for non-payment of final fees was 5,034. The total receipts were $1,343,779; the expenditures, approximately, were $1,026,644, leaving a surplus of $317,135. The moneys covered into the Treasury of the United States on account of receipts from fees, etc., in patent cases, from July 4, 1836, in excess of the cost of the management of the Patent Office, amounted to $5,093,614.

Nature states that an instructive fisheries exhibition, arranged to illustrate the fishing industries and the application of science to agriculture, has been opened in the Zoological Museum of the University College, Liverpool. The exhibits are fully described in a guide to the exhibition published by the authorities. There is a series of the food fishes of this district, with the more important food matters of each; also a series of useful and useless fishes

which compete with one another by eating the same food. Another exhibit contains specimens of the shell-fish of the district, showing stages in the life-history and growth, legal and illegal sizes, pearl formations and pearls. A case is devoted to a display of printed matter, photographs, drawings and lantern slides, illustrating the publications, both administrative and scientific, of the Lancashire Sea Fisheries Committee, and other work bearing upon the fisheries of the district. The drawings and sketches include a number made by Professor Herdman in illustration of his joint investigation with Professor Boyce on the diseases of oysters and the connection between the oyster and disease.

THE *Senckenbergische Naturforschende Gesellschaft* at Frankfort celebrated its eightieth anniversary on May 30th, and has now published its *Bericht*, giving an account of the celebration, including the official address by Professor Heinrich Reichenbach, the subject of which was 'A Review of the Progress of Biology during the Past Eighty Years.'

THE seventh International Congress of Navigation will be held at Brussels during July of next year.

THE Walsingham Medal for 1898 is offered at Cambridge University for a monograph or essay giving evidence of original research on any botanical, geological or zoological subject, zoology being understood to include animal morphology and physiology. The competition is open to graduates of the University who are under the standing of M. A. on October 10, 1898, on or before which date the essays are to be sent to Professor Newton, Magdalene College.

THE trustees of the New York Public Library, Astor, Lennox and Tilden Foundations, have announced that the design submitted by Carrere & Hastings for the new library building, to be erected on the site of the Forty-second street reservoir, has been accepted, and the prize in the competition awarded to that firm.

IN addition to the relief map of the State and of the Catskill regions issued by the University of the State of New York, the Regents have authorized one of the Adirondacks and another of Manhattan Island which will show its physical features before they were altered by civilization. The chief interest of this action is, however, in the notice to university institutions that duplicates of these relief maps will be made in quantity and furnished to the schools either for cash or as a part of their apportionment at a comparatively trifling cost, so that many schools can hereafter be provided with these valuable maps. 1,000 copies of the mushroom charts, the publication of which created so great interest that the edition was exhausted almost immediately, have been ordered by the Regents in chart form for wall use. Each institution will be entitled to one free in sheets or mounted on muslin and rollers by paying the cost of such mounting.

THE library of the late Professor Carl Vogt has been purchased by the Senckenbergische Naturforschende Gesellschaft of Frankfurt.

THE Paris *Conservatoire Nationale des Arts et Métiers* announces a series of public and free courses of lectures on the application of science to the arts. These lectures are given in the evenings and continue throughout the winter. The lecturers include M. J. Hirsch, M. J. Violle, M. Marcel Deprès, M. Th. Schloesing and other eminent French men of science.

AT the anniversary meeting of the New York Academy of Medicine, on November 18th, an address was given by Dr. Hermann M. Biggs on 'Sanitary Science, the Medical Profession and the Public.'

A REPORT by M Descubes has been presented to the French Chambers of Deputies recommending the plan of connecting Paris with the sea by a maritime canal, proposed by M. de la Grie. The length of this canal would be 185 km., its width at least 35 m., and its depth 6.20 m. The cost is estimated at about $30,000,000, and M. de la Grie is prepared to organize a company to construct the canal if it is allowed the right to collect tolls for ninety-nine years.

AT a recent meeting of the New York Library Club, Dr. John S. Billings described the method of disinfection of books by formalin vapor. He said, according to the New York *Medical Record*, that in some experiments made recently, at the laboratory of the University of

Pennsylvania, a saucer of formalin, a book which had been infected with the bacteria of diphtheria, another with scarlet fever, and another with erysipelas, were placed under a bell jar. The experiment showed that one cubic centimeter of formalin to three hundred cubic centimeters of space would thoroughly disinfect any book in fifteen minutes.

IT is possible that the beaver will survive longer in Europe than in America. It is said that a few individuals are still to be found on the Elbe, the Rhine and the Danube, and Professor Collett, of Christiania, estimates, according to *Cosmos*, that there are now 100 individuals living in Norway, whereas the number in 1880 was estimated at 60. Professor Collett recommends that government protection be afforded to prevent their extermination.

DR. MAX SCHLOSSER has just issued his *Litteraturbericht* of Anthropology and of the Living and Fossil Mammals for the year 1893—a quarto abstract of 82 pages, in fine type, containing critical notices and digests of all the contributions to these subjects during the year. This abstract is from the *Archiv für Anthropologie*, Band 24, and it is an invaluable aid to zoölogists and paleontologists in all parts of the world, especially because it gives the contents of many papers which are not accessible to readers on this side of the water.

DR. BERGER has published the original Italian text, with comments, of a manuscript discovered by him in the Vatican Library in the hand writing of Michael Angelo. It gives a series of prescriptions and treatments for diseases of the eye which it is supposed he collected in view of his own failing eyesight.

THE last issue of the Masters of Medicine series, published by Mr. Fisher Unwin, London, is 'William Harvey,' by D'Arcy Power.

THE *Atlantic Monthly* promises for next year a series of articles by Mr. John Muir, describing The Great Government Reservations, The Yellowstone Park, The Yosemite Park, and The Sequoia Parks; a series by Dr. T. J. J. See on the 'Origin of the Universe,' and a group of articles on modern psychology and its contributions to education, as also articles by Professor C. S. Sargent on the preservation of the forests and by Professor D. G. Brinton on results of American archæological investigations.

MR. BERNARD QUARITCH, London, offers for sale a complete set of the 'Philosophical Transactions of the Royal Society' for £240. The set includes the 'Philosophical Collections' by Robert Hook, seven numbers complete, published in 1679–1682, during which time the Philosophical Transactions were interrupted, which were intended to supply the gap.

THE Open Court Publishing Company, Chicago, propose issuing a series of life-size portraits of eminent philosophers and men of science, should the advance subscriptions warrant the undertaking. They have prepared a preliminary list of sixty-two philosophers and psychologists and offer this set for $7.50. We trust that this very reasonable price, and the value of the work already done in this direction by the Open Court Publishing Company, will secure a sufficient number of subscriptions to lead them to publish the series, and to follow it as they suggest with series of mathematicians, physicists, biologists, etc.

IT is perhaps worthy of note as indicating tendencies of scientific development that of the thirty-six philosophers given in the series drawn up by the Open Court Publishing Company all are dead except one, whereas a large proportion of the psychologists are now living. The list of psychologists is as follows: Cabanis, Maine de Biran, Beneke, G. E. Müller, E. H. Weber, Fechner, Helmholtz, Hering, Aubert, Mach, Stumpf, Munk, Exner, Wernicke, Steinthal, Brentano, Paul Janet, Ribot, Taine, Fouillée, Binet, Bain, Romanes, C. Lloyd Morgan, Bastian, William James. The omission of Wundt's name from the list is probably through inadvertence. In the English names biology is emphasized at the expense of psychology. The names of Ladd and Hall should be added to give America its fair representation.

THE Smithsonian Institution is about to print, in its *Miscellaneous Contributions*, a work entitled 'List of Recorded Earthquakes on the Pacific Coast, 1769–1897' (illustrated), by Edward S. Holden. The data are derived from a similar list of recorded earthquakes, 1769–1888 (with a very considerable number of additions

and a few corrections), which was issued by the University of California in 1888, and from the annual publications of the Lick Observatory (printed in the *American Journal of Science*, the *Publications* of the Astronomical Society of the Pacific, the *Bulletins* of the United States Geological Survey) since that date. The annual records referred to have been compiled by Messrs. Holden, Keeler and Perrine from observations at Mt. Hamilton, and from miscellaneous reports of earthquake shocks. They have been thoroughly sifted and revised in the present work, which is believed to contain all trustworthy data on the subject of Pacific coast earthquakes since 1769.

IN a monograph entitled 'A revision of the American Lemnaceae occurring north of Mexico,' printed in advance from the Ninth Annual Report of the Missouri Botanical Garden, Mr. C. H. Thompson, in continuation of his studies of ligulate Wolffias, published in the Eighth Report, has now brought together, in concise form and with good keys, a synopsis of the entire Order Lemnaceae, as represented in our flora, each species, in addition to a good description, being represented by excellent figures illustrating its habit and structural details. The paper should stimulate increased study of this interesting group of aquatics, the smallest of flowering plants.

WE understand that subscriptions toward the purchase of the paleontological collections of the late Professor Cope for the Philadelphia Academy of Natural Sciences are far from reaching the needed sum. A recent issue of the Philadelphia *Ledger* contains an editorial urging the importance of securing these collections. It remarks:

"The public spirit of the citizens of this city should not make it possible for the collections to be taken elsewhere, as they embrace many of the specimens on which Professor Cope based his original descriptions, and this type material is simply priceless, since it cannot be duplicated. If through the liberality of those interested in the progress of science the Academy of Natural Sciences be placed in possession of this material, that institution will then have in its museum the type collections of Leidy and Cope, two of the greatest authorities on the monsters of the pre-historic world."

SIMULTANEOUSLY with the starting of the railroad at Buluwayo, says the New York *Tribune*, comes the news of the discovery of coal in large quantities in the immediate neighborhood of the place, the prospectors having been able to ascertain that the coal fields in question cover an immense area, extending, indeed, to the Zambesi river. It is this discovery, destined to play so great a rôle in the commercial and industrial development of the southern portion of the Dark Continent, that has led Cecil Rhodes to decide to continue the railroad without delay to the Zambesi river, which will then be in uninterrupted railroad communication with the Cape. Apart from their commercial importance the coalfields may contain fossils of great scientific interest.

UNIVERSITY AND EDUCATIONAL NEWS.

A NEW University was opened at Jassy, Roumania, on November 2d, addresses being made by the king and by the queen of Roumania.

BY the will of the late Julia Bradford Huntington James a trust fund left by the late Ralph Huntington was released, and it appears that the Massachusetts Institute of Technology and the Boston Museum of Fine Arts will each receive about $100,000.

THE Root Hall of Science and the Benedict Hall of Languages of Hamilton College were dedicated on November 16th. The buildings are both of stone and each cost about $30,000. The Hall of Science is the gift of Mr. Elihu Root, of New York, in memory of his parents, his father having been professor of mathematics in Hamilton College. His brother, Oren Root, now holds the same chair.

ARRANGEMENTS are being made to build a science hall at Ripon College, costing $30,000. Five subscriptions of $2,500 have already been received.

ROCKFELLER HALL, the new recitation building given to Vassar College by Mr. John D. Rockfeller, at the cost of $100,000, was dedicated on November 19th. Dr. G. Stanley

Hall, President of Clark University, gave an address on 'A Few Tendencies in College and University Education.'

THE New York *Evening Post* gives the following summary of the attendance at Yale University for the past four years:

	1894.	1895.	1896.	1897.
Graduate	138	176	227	260
Academic	1,150	1,199	1,237	1,242
Scientific	662	584	553	542
Art	41	46	53	77
Divinity	116	105	104	102
Medical	100	125	138	134
Law	195	224	213	194

The decrease in the scientific school is due to the loss of some eighty students who attended under the old land-grant fund régime. The freshmen academic class is the smallest of the five classes this year, whereas there is an increase in the scientific school of 16 students over last year's class.

A CONVENTION of American women propose to assemble in Washington on December 14th to decide on ways and means of arousing public sentiment in favor of a national university. They intend, it is said, to collect the $250,000 necessary for the erection of an administration building, to form the nucleus of the university, and hope to be able to lay the corner stone on February 22, 1899.

THE vacant professorship of pathology at Cambridge University has been filled by the election of Mr. A. A. Kanthack, M.A., of St. John's College, who has acted as deputy for the late Professor Roy. Professor Kanthack, as we learn from the London *Times*, has had a distinguished career at the University of London, where he has taken with honors the degrees of B.A., Bachelor in Surgery, Bachelor in Medicine, was gold medalist, and proceeded to the degree of M.D. in 1892. He has pursued his studies at University College, Liverpool; St. Bartholomew's Hospital, at the Universities of Berlin and Cambridge. His introduction to Cambridge was in 1891, when he was elected to the John Lucas Walter studentship of the value of £200, open to all students for the purpose of conducting original research in pathology. Before that year he had been lecturer in pathology at St. Bartholomew's Hospital, medical tutor at the Royal Infirmary, Liverpool, and senior demonstrator in pathology at University College, Liverpool. He has devoted many years to original research, and was a member of the Leprosy Commission in India. He is the author of a Manual of Practical Morbid Anatomy and of a Handbook of Practical Bacteriology, and also an extensive and frequent contributor to the journals of physiology and anatomy.

DR. THEODORE DES COUDRES has been promoted to an associate professorship of physics in the University at Göttingen and Dr. Otto Knopf to an associate professorship of astronomy in the University at Jena. Dr. Schmitz-Dumond, of Tarand, has been appointed Director of the Agricultural Experiment Station to be established in Pretoria and Dr. A. Ostroumoff to be professor of zoology in the University of Kasan. Professor Küster, of Göttingen, has been appointed head of the division for analytical, inorganic and physical chemistry in the Chemical Institute of the University at Breslau.

DISCUSSION AND CORRESPONDENCE.

THE MESA ENCANTADA.

TO THE EDITOR OF SCIENCE: I thought that I had said the last word as far as I was concerned upon the subject of the Mesa Encantada, but now that Mr. Hodge's pictures have appeared there is one more word to be said. I never dreamed that he or anybody else would have mistaken the manifestly modern and humanly constructed *cairn* which he figures, and about which so much noise has been made, for the *cairn-like* object of which I spoke. The latter is a very different object, and its location gave it some significance, while the former has none of any importance.

The cairn he figures was certainly built by a human being on the 23d of July, 1897, and not by ghosts.

WILLIAM LIBBEY.

PRINCETON, N. J., November 16, 1897.

OBSERVATIONS ON 'THE PRINCIPLE OF IDENTITY.'

THE principle that a thing or relation is identical with itself has given no end of trouble in

discussions respecting experience and knowledge. More than often it has been regarded as an abstract form of self-evident apprehension, whose chief, and perhaps sole, function is to mark the limits of reasoning. How it may have come into our experience has been humorously and seriously debated from Locke downward. It may not be an exact source of knowledge, but this negation does not exclude the peculiar significance attached to *experiencing* the relation in question. The two cases following indicate that there is some meaning to the 'principle' when found in conscious processes at an earlier time.

A bright child, Helen B., four years of age, whose development has been normal in all particulars, perplexed her mother and myself by adding to a conversation, in which she was taking no part and which had no apparent concern for her, these words: "Whatever is alike is the same. If you are good, you have to be good; if you are bad, you have to be bad. Whatever is alike is the same." Tactful questioning failed to bring out any evidence that the utterance was an echo from something the child may have heard. The meaning of the statement seemed to be clear to the child, though able to explain or expand it in no other way. She persisted in the assertion with considerable show of feeling, amounting almost to triumph.

Another and more recent instance is that of a boy in his sixteenth year. In a certain class the teacher was endeavoring to get another pupil to complete the sentence, "A dog is—," for purposes of illustration. After several examples and some hesitation on the part of the second pupil, the first jestingly ventured to supply 'a dog,' the sentence then reading: "A dog is a dog." The teacher accepted the suggestion as 'all right,' and showed how such statements could be made. The boy, however, was confused with astonishment upon learning that his suggestion had passed from jest to earnest, and required a rather long period of time to recover and adapt himself to this relation, which had apparently never occurred to him previously.

These rather opposite cases go to show that the 'principle' is not utterly void when it first arises in the conscious processes, however thoroughly one may claim it to have been operative in primitive mental activities.

EDWARD F. BUCHNER.

NEW YORK.

SCIENTIFIC LITERATURE.

A Popular Treatise on the Physiology of Plants for the Use of Gardeners, or for Students of Horticulture and Agriculture. By DR. PAUL SORAUER. Translated by F. E. WEISS. London and New York, Longmans, Green & Co. 1895.

One of the excellent features of this book is that there has been a consistent endeavor on the part of author and translator to make it a book clearly within the grasp of the persons for whom it is intended.

The author has succeeded in dealing with many of the problems of nutrition, diffusion, assimilation, etc., in a way that is not only attractive, but can be understood by one who has had little previous training in the study of plants.

After the introduction the author takes up first the structure of the root, and in connection with the structure discusses also the function of the root in the processes of absorption and conduction of nutrient materials. This is followed by a chapter on the nutrition of the root, dealing with the substances in the soil which act as plant food, the effect they have on the plant and the form in which they are taken up by the plant. Practical suggestions are made concerning the best treatment of the soil, the nutrition of pot plants, etc. The treatment of roots in transplanting, in repotting, is also considered.

The structure of the stem and leaf are treated in the same readable way in relation to the functions which they play in the general plant economy. The remaining chapters are devoted to plain directions for pruning, propagating, watering and the general nurture of the plant and seed, from the standpoint of the horticulturist and gardener, and this part of the book, at least to one who deals more with the principles of plant development than with horticultural practice, seems to be admirably done.

GEORGE F. ATKINSON.

Contributions to the Analysis of the Sensations. By ERNST MACH. Translated by C. M. WILLIAMS. Chicago. 1897.

The English-reading public is not a little indebted to the Open Court Company for its rendering into English of some of the best foreign writers of our day. Mr. Williams's careful translation of Mach's 'Analysis of Sensations' is a particularly valuable contribution.

In turning again to a work that has been before the public some twelve years, it will be unnecessary to take up anew the discussion of the particular problems treated. The part played by movement, either actually performed or merely 'willed,' in our perception of space (p. 60, etc.), by the mechanism of attention with its background of continuous bodily processes in our sense of time (p. 111, etc.)—the parts played by these factors have come to be well recognized items in our psychological stock-in-trade. Mach's contributions to the subject remain historically interesting as early, clear and richly illustrated efforts to call attention to these elements in our concepts of space and time. His attempt to reconstruct the psychology of tone, if it has not met with any such general acceptance, presents, nevertheless, a method of treatment that no tone-psychology can afford to pass over without notice. Since the fundamental concepts involved go beyond the special field of audition and serve to illustrate an attitude toward the whole psychology of sensation, reference to them may be left for that connection.

The present review may thus confine itself to a discussion of the points of broader interest for which Mach stands. Such a task in connection with the work before us is rendered pleasant by the author's simplicity of style and limpid clearness of thought. It is rendered difficult, on the other hand, by the desultory plan of treatment that he has consciously adopted. For although we are assured in the original preface that the same problem has been kept in mind throughout, yet to justify such a statement one must consider the problem to be a very general one, indeed.

Mach paves the way to the more technical part of his discussion by sketching in a most skillful manner a view of science in general, of psychology as a particular science, of the problem of sensation as illuminated by these general considerations. It is this part of the discussion that appears to the reviewer to be the central interest of the work. One feels, too, that it lay nearest the heart of the author. It seems, then, to demand rather close attention.

Having swept the decks of such 'metaphysical' concepts as 'things-in-themselves,' science starts with complexes of experience, partly permanent, partly changing (p. 2). Among the relatively permanent complexes are the 'self' and the various groups we call bodies. Their permanence is, however, only relative; the division between them not fixed. The changes to which they are subject furnish an instigation to that analysis by which they are disintegrated into 'elements' (p. 5). These elements, for economic purposes grouped together under single names, separated into not very definite wholes, are, in the end, all alike 'sensations' (pp. 10, 152). Thus 'the world consists only of our sensations' (p. 10).

Starting from this empirical 'monistic' standpoint, it is with the 'connections' of this small number of ultimate elements that science deals (p. 18). The fields of the various sciences are defined, not by the kinds of elements they consider, but by the kinds of connections they take into account. Thus, the ordinary division between mind and body and the separation of sciences dealing with each is, like any other distinction between particular sciences, purely a practical device. "That traditional gulf between the physical and psychical research, accordingly, exists only for the habitual stereotyped method of observation" (p. 14). "There is no rift between the psychical and the physical, no *within* and *without*, no *sensation* to which an outward, different *thing* corresponds. There is but *one kind of elements*, out of which the supposititious within and without is formed—elements that are themselves within and without according to the light in which, for the time being, they are viewed" (p. 151). The same elements, viewed as connected in those groups that we call physical bodies, are objects of study for physics; when one of these physical bodies is regarded as an organism their connection is studied by physiology; when considered as a chain of mental events they offer the subject-matter for psychology (p. 153). Thus, all science is primarily an attempt to reproduce facts in

thought. All that it seems to be more than a detailed account of facts arises from the necessity of performing its function in an economical, even though symbolical, way (p. 154).

The empirical, phenomenalistic standpoint above defined is, perhaps, as satisfactory a basis for scientific development as can at present be formulated. It would, of course, be hasty to regard it as a final formulation. That it contains inherent difficulties must have been as evident to the author as it is to the critic. For example, when it is said 'the world consists only of our sensations' one naturally wonders where the frequently mentioned 'connections' between sensations are to come in. Or, again (the historical stumbling block of 'monism'), what is this experiential, or phenomenal, or sensational character, which, if everything possess it in common, would seem to be as difficult to define as a scholastic 'summum genus'? Finally that 'self' which is a group of sensations, an object of experience, conveniently separated on the basis of certain peculiarities it may possess from other objects, is left in undefined relation to that subject or observer by whom and for whose 'economic' ends the separation is made. Again the historic difficulties surrounding the relation of the self as subject to the self as object!

Nevertheless, it is not probable that any other theory removes these difficulties, although many seem more profoundly conscious of their existence. Their clearness and practicability have made views similar to those of Mach, favorite among scientists (cf. Münsterberg, Karl Pearson, *et al.*). Doubtless more elaborate care expended on the foundation would be out of proportion to the strength of the present scientific superstructure that rests upon it.

From the consideration of these general question Mach turns to his special problem, the psychology of sensation. The ideal of his effort he holds to be the determination of the 'connection of the psychologically observable data with the corresponding physical (physiological) processes' (p. 29). The guiding thread of such a research must be 'the principle of the complete parallelism of the psychical and physical' (p. 30).

It is but a step further to assume as many physico-chemical neural processes as there are distinguishable qualities of sensation (Pref. to Eng. ed.). Similar principles of research are largely admitted and follow naturally from the concepts of Bell and Müller. But the question remains open as to whether different qualities of sensation are to be related to numerically different structures, or whether likeness and difference of mental status are to be related to qualitative likeness and difference of physico-chemical processes taking place in nervous structures whose numerical distinctness, even if existent, is accidental. Mach declares himself for the latter hypothesis, and an illustration is furnished in his treatment of tone-sensations. If, in this field, we look, with Helmholtz, for a special end organ corresponding to each pitch, likeness and difference of tones mean the excitation of the same and of different end organs, a point of much consequence in the theory of harmony. If, on the other hand, we regard the quality of the process that takes place in an end organ as a factor in the result, we might assume with Mach that every end organ is the seat of two kinds of energies (say a 'Dull' and a 'Clear'), the various ratios in which the two are excited being the physiological determinant of the pitch (pp. 128, 143, etc.). Two notes may then be more or less alike, although dependent upon numerically distinct end organs, since each involves the same two specific 'energies,' only in different ratios. Mach is thus enabled to give a physiological basis to that theory of harmony which makes it depend upon the presence of common overtones. All tones are more or less alike; harmonious tones are more alike than others, because their common (physiological) overtones reinforce each other (p. 144, ff.).

The particular tone theory presented by Mach, although highly ingenious, and although it has won for itself some protagonists (*e. g.*, Wundt), becomes a little strained when we try to explain why two simple tones of different pitch are not identical with one tone of intermediate pitch (p. 129). Still the general principle of sense physiology, on which the theory rests, is of the greatest interest. Those who would object that progress in the physiology of the senses has been in the direction of differentiating numerically distinct structures corresponding to

qualitative differences of mental states, must square their antipathy to Mach's theory with the prevailing acquiescence in the view that regards intensity differences as adequately explained by relating them to differences in the energy of excitation of the same physiological structure. It is only a step further to explain differences of quality by relating them to differences in the *ratios* of the energies involved in the excitation, either of the same, or of similar structures. Either our psychology of intensity must be brought into line with the progress of qualitative differentiation or the field must be left open to such theories as that of Mach.

The reviewer agrees with the translator that the matter contained in Mach's little work is by no means so limited as the number of pages. He offers this as an excuse for having passed over many points in the discussion more lightly than their importance deserved.

EDGAR A. SINGER, JR.
UNIVERSITY OF PENNSYLVANIA,
August, 1897.

SOCIETIES AND ACADEMIES.

ENTOMOLOGICAL SOCIETY OF WASHINGTON.

OCTOBER 14, 1897.—Mr. Schwarz spoke of the remarkable collection of insects recently made by Mr. H. G. Hubbard in southern Arizona. This collection is the most extensive and valuable which has been made in that part of the country. In Coleoptera alone it contains between 300 and 500 species new to the fauna of the United States. He exhibited a specimen of the myrmecophilous Scarabæid *Lissomelas flohri* Bates, a genus new to the United States and allied to Cremastochilus. The specimens collected by Mr. Hubbard were not found in ants nests, nor could any traces be found of thoracic glands which are supposed to be attractive to ants. The insect fauna of Arizona and southern California was discussed at some length by Messrs. Schwarz, Gill and Fernow. Mr. N. Banks exhibited specimens of *Chrysopa ypsilon*, each of which carried one or more minute Cecidomyiid flies on its wings. The specimens were collected by Mrs. Slosson in the White Mountains, and Mr. Banks considers that the Cecidomyiids use the Chrysopas as a means of locomotion. Mr. Ashmead mentioned a parasitic wingless fly of the family Borboridæ collected by Mr. O. F. Cook in Liberia, which uses a common snail for transportation purposes. Mr. Ashmead described a new genus of Cynipidæ from Liberia which he will call *Curriea*, after the collector, Mr. R. P. Currie. It is the only genus of the Cynipidæ with toothed hind femora, and bears a superficial resemblance to certain Chalcididæ. Mr. Howard read a short paper entitled 'Notes on the House-fly,' which gave rise to a discussion on the carrying of contagion by house-flies, in the course of which Mr. D. G. Fairchild described at some length a serious eye disease prevalent in the Fiji Islands, which is carried by the house-fly. Mr. N. Banks read a paper entitled 'A New Species of the Genus *Halarachne*,' the typical specimens of which had been taken from the bronchial passages of a seal which had died in the National Zoological Park. Mr. Ashmead read a paper entitled 'On the Genera of the Xyelinæ.'

November 4, 1897.—Mr. Ashmead showed specimens of the male of *Pelecinus polyturator* from Indiana. The female of this species is very common, but the male is extremely rare. Mr. Ashmead thinks that this insect, the habits of which are not yet known, is probably parasitic upon some Coleopterous wood-borer, a conclusion which was discussed at some length by Messrs Schwarz and P. R. Uhler. Mr. O. F. Cook exhibited specimens of *Peripatus novazealandica* and of two small species of *Peripatus* from the Bismarck Archipelago. Mr. Schwarz exhibited specimens of *Cychrus mexicanus* Bates, a species new to the fauna of the United States, captured by Mr. H. G. Hubbard, at Cave Creek, Arizona. Mr. Howard exhibited specimens of *Trypeta acidusa* Walker, reared from ripe peaches by Mr. A. Koebele, at Orizaba, Mexico, and spoke of the Mexican distribution of *Trypeta ludens*. The subject of the possible establishment of these fruit pests in the United States was discussed by Messrs. Howard and W. G. Johnson. Mr. O. Heidemann read a paper on 'Hemiptera found on the Ox-eye Daisy,' listing twenty-nine species and giving notes on their habits. Mr. O. F. Cook read a paper on 'New Dicellura,' an order which he has erected to include the allies of Japyx. He exhibited plates of ten species and showed specimens of a new

African form which he thinks will form a new family in which the forceps are replaced by stylets. Dr. H. G. Dyar read a paper on 'Some Structural Points in Saw-fly Larvæ.' Mr. N. Banks presented a paper on an 'American Species of the Genus *Cæculus*,' a genus new to the United States and previously known only in Europe. Professor P. R. Uhler exhibited a series of American Notonectas and spoke of the distribution and structural peculiarities of the genus. As a result of the recent studies of Mr. G. W. Kirkaldy nine valid species are now known from the United States.

L. O. HOWARD,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON—281ST MEETING, SATURDAY, NOVEMBER

PROFESSOR LESTER F. WARD exhibited specimens of *Prosopis juliflora* from Kansas, a species not previously found in the region of Gray's Manual; also of *Psoralea tenuiflora*, remarkable as a tumble-weed, and of *Lotus americanus*, a peculiar 'compass-plant.'

Mr. E. L. Morris showed some alcohol specimens of various vertebrates and invertebrates illustrating methods of sectioning to show the alimentary canal.

Mr. Charles L. Pollard presented 'A Publication Problem in Botany,' drawn from Rafinesque's Florula Ludoviciana. This book was practically compiled from the list of plants given by a Frenchman, Robin, who had traveled extensively in Louisiana, and had made numerous field observations and descriptions. Rafinesque based many of his new genera and species on these field notes, never having seen any type material, and Mr. Pollard asked for an expression of opinion on the tenability of these names, explaining that botanists of the present day are divided on the question. The consensus of opinion in the Society, elicited by discussion, favored the retention of the names in all cases where they were identifiable.

Dr. M. G. Motter presented a paper on 'Underground Zoology,' being the result of a careful examination of a large number of disinterred human bodies with a view to ascertain the species of animals and particularly of insects that might be present in order to test Mégnin's 'Application of Entomology to Legal Medicine.' Some 75 species belonging to 60 genera were noted and the conclusion drawn that so far as the evidence of his observations was concerned the medico-legal aspect of cadaverine entomology was enveloped in a haze of uncertainty, not to say doubt.

Mr. F. A. Lucas spoke of the 'Fossil Bison of North America,' saying that while remains were widely scattered over the United States the species were known mostly from horn cores, and owing to lack of correlation of these with other parts they could not be satisfactorily diagnosed. He recognized six species besides *Bison bison*, viz.: *Bison alleni*, *antiquus*, *crassicornis*, *ferox*, *latifrons* and *scaphoceras*. *B. crassicornis* of Richardson, which had been confounded with various species, was perfectly distinct, while *B. crampianus* was probably synonymous with *B. alleni*.

Dr. C. Hart Merriam described the 'Life-zones of the Olympic Mountains,' noting the flora and fauna of the region at some length. But two zones were distinguishable, a Hudsonian and a mixed Transition and Canadian.

F. A. LUCAS,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the 67th regular meeting of this Society, the first meeting of the course of 1897–98, held in Washington, D. C., on November 10, 1897, Mr. Lester F. Ward read a paper on the Cretaceous Formation in Southwestern Kansas. Mr. Ward had made a study of the Cheyenne formation, as well as of all the Cretaceous deposits in that region lying between the Red Beds and the Tertiary.

The principal section lay along the Medicine Lodge River, extending from a point near Sun City, in Barber county, to Fullington's ranch, near the extreme head of that stream, in Kiowa county. The center of operations was at Belvidere, and all of the most typical exposures of the Cheyenne occur within a radius of ten miles from that point. A reconnaissance was also made to the southwest as far as the Avilla Hill, five miles south of the town of Avilla, in Comanche county, and thence northwestward to Mt. Nebo, St. Jacob's Well, the Big Basin,

and the various draws and breaks on Little Sandy creek, Chatman creek, Bear creek, Bluff creek and Hackberry creek, where the Cretaceous formation, is extensively exposed. The following is a brief summary of the general results:

The Cheyenne formation rests everywhere unconformably upon the Red Beds, occasionally with a gravel bed at its base. It is a good geological unit, clearly marked off from the overlying Kiowa, the lowest member of which forms a thin ledge of marine shells, the Champion of Cragin. The lower part of the Cheyenne is almost always a massive sandstone, often cross-bedded, pure white, or more frequently stained yellowish. It contains no admixture of clay, but occasional thin clay shales, and very rarely more or less lignite. Near its base silicified wood occurs, at some points in considerable abundance. This bed, No. 1 of Hill, the 'Coral Sandstone' of Cragin, varies greatly in thickness, but where well preserved reaches 50 feet. In typical exposures this is overlain by some 15 feet of carbonaceous shales, consisting largely of dark, sandy, stratified clays, much lignite, and abundant vegetable remains, usually matted and confused so as to yield few determinable impressions. This is the No. 2 of Hill's section, the 'Lamphier Shales' of Cragin. Above this is the 'Stokes Sandstone' of Cragin, Hill's No. 3, having a thickness of some ten feet and consisting of stratified sandstone of a somewhat darkish or grayish color, considerably argillaceous and carbonaceous and often holding plant impressions. The character and relations of these upper beds, however, were found to vary so extensively that this subdivision has very little value. A large collection of fossil plants, amounting to 44 boxes, with an aggregate weight of about 3,000 pounds, was made in these upper beds and has been received at the U. S. Geological Survey.

The Cheyenne is confined exclusively to what may be called the Belvidere region, chiefly along Medicine Lodge river, as above noted, but passing southward along the head of Elk creek, across Mule creek and Indian creek, some six miles southeast of Nescatunga, forming a sort of crescent. It does not occur in the Avilla Hill nor anywhere in Clark county, so far as Mr. Ward was able to observe; the rocks of the former region, supposed by Prosser to represent the Cheyenne, being wholly different and belonging to the lower Kiowa beds, underlain by black papyraceous shales; and the Big Basin Sandstone, which Prosser also referred to the Cheyenne, being clearly, as Cragin states, nothing but the upper indurated portion of the Red Beds, the top of which is almost always whitened.

Perhaps the most important result of this expedition was the discovery of the true base of the Dakota group in a series of remarkable beds, nearly 200 feet in thickness and not hitherto described, forming an uninterrupted transition from the Kiowa Shales, holding Gryphæa and Exogyra, to the typical Dakota Sandstone, yielding characteristic dicotyledonous leaves, a small collection of which was made. Mr. C. N. Gould, who was a member of Mr. Ward's party, and who had previously seen most of these deposits, will soon publish a paper setting forth their relations in detail.

Under the title 'The Geological Sequence in Jamaica,' Mr. Robert T. Hill presented an account of the stratigraphic succession in Jamaica, describing the various rocks of igneous, sedimentary, oceanic and organic origin and their relations. Mr. Hill's paper was an extract from his report to Professor A. Agassiz, under whose auspices the studies were made. In discussing the elevated coral reefs he stated that there can be no possible doubt but that they were formed around emerging land, as held by Agassiz.

W. F. MORSELL.

U. S. GEOLOGICAL SURVEY.

NEW YORK ACADEMY OF SCIENCES—SECTION OF GEOLOGY—NOVEMBER 15, 1897.

THE first paper of the evening was by Dr. F. J. H. Merrill, of the State Museum at Albany, entitled 'Geology of the Vicinity of Greater New York.' Dr. Merrill considered the distribution, relations and structure of the Crystalline, Metamorphic and Intrusive rocks east of the Hudson. He noted particularly in the vicinity of New York City the Pre-Cambrian Fordham Gneiss, overlain at certain places, as

at Lowerre, Hastings, Sparta and Peekskill, by a very thin bed of Quartzite, probably representing the Georgian Quartzite of Dutchess county. Above this is a thick series of Crystalline Limestones, forming the river valleys of the Harlem, Bronx and other rivers, and underlying most of the navigable water ways in the vicinity of New York. The upper rocks are Mica-schists, which are probably of Hudson River age, and make most of the highlands of New York City and vicinity. These rocks are extensively folded in a general direction of N. 40° E., with occasional cross foldings, producing the cross valleys. The whole series is crossed by the Manhattanville Fault, running from Manhattanville, North River, southeastwards to the East River, between Ward's and Blackwell's Islands, into Astoria Bay. The fault, along which there has been a throw of a number of hundred feet, was long ago described by Professor Dana.

The second paper of the evening was by Captain J. J. Riley, entitled 'The Guano Deposits of the Islands of the Southern Pacific, and their Prehistoric Remains.' Capt. Riley considered in detail the depth, value and manner of working of the guano deposits in the Chincha Islands, off the southern coast of Peru, from which guano was first taken by Humboldt in 1804, and which have since been very famous for their guano deposits. Between 1850 and 1880 it is estimated that guano to the value of $550,000,000 in gold was taken from three islands alone. The islands lie in the rainless region, and the preservation of the guano is due to the absence of water. Once in about seven years there is a season of quite a little rainfall, which has undoubtedly a great effect upon the guano, and was considered by Captain Riley to be the cause of the blacker bands in the layered deposits. Two burial tombs containing bodies of great antiquity have been discovered in the guano. The bodies were evidently those of royal personages, and apparently, from the evidence of slabs containing certain symbols, related to the Incas. These tombs were found at a depth of 35 and 68 feet, but it is not possible to state whether they were buried in the guano or later covered by it. The islands, three in number, are granitic in character, and were covered by a varying thickness of guano, reaching in the more important island a depth of 203 feet in places. The exportation of guano has, however, ceased since 1880.

In the discussion Dr. Julien compared these islands with other guano-bearing islands of the West Indies, paying particular attention to the absence of any evidences of human remains showing life coincident with the formation of the guano.

The third paper, read by title, was by Mr. Stuart Weller, and entitled 'A New Crinoid from the Coal Measures of Kansas.'

RICHARD E. DODGE.
Secretary.

BOSTON SOCIETY OF NATURAL HISTORY.

THE first general meeting of the season was held November 3d, seventy-five persons present.

Mr. J. B. Woodworth spoke of Mr. Saville-Kent's work concerning the Great Barrier Coral Reef of Australia. He sketched briefly the chief results of the studies of Darwin and others upon the theory of coral reefs and showed a series of lantern slides giving a general view of the life upon the Great Barrier Reef. This reef stretches along the coast for a distance of more that 1,200 miles; the distance from the outer edge of the reef to the mainland varies from 10 to over 100 miles. The reef and adjacent waters abound in Nullipores, Madrepores, Alcyonarians, Holothurians, etc. The pearl and pearl-shell, Trepang and oyster fisheries are of very great importance.

SAMUEL HENSHAW,
Secretary.

NEW BOOKS.

Bau und Leben unserer Waldbäume. M. BÜSGEN. Jena, Gustav Fischer. 1892. Pp. viii+230.

Handbuch der Klimatologie. JULIUS HAUN. Stuttgart, J. Engelhorn. 1897. 2d edition, revised and enlarged. Vol. I., pp. xii+404; Vol. II., pp. viii+384; Vol. III., pp. viii+576.

Essai sur les conditions et les limites de la certitude logique. G. MULHAUD. Paris, Alcan. 1898. 2d edition. Pp. viii+202. 2 fr. 50.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; C. E. BESSEY, N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; C. S. MINOT, Embryology, Histology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE UNITED STATES FISH COMMISSION.

ACCORDING to law the United States Fish Commissioner must be a man of 'proved scientific and practical knowledge of the fishes of the coast.' If President McKinley judges that Mr. Cleveland violated the law in appointing to the position the cousin of a prominent Democratic politician, having no previous scientific knowledge or practical experience in the work, retired from the navy owing, it is said, to rheumatism, aggravated by sea air, and if further the incumbent has not during the past two and a-half years acquired 'scientific and practical knowledge of the fishes of the coast,' then it is the President's duty to remove the present Commissioner and make a new appointment according to the requirements of the law.

We think that the President could best secure information on the subject by appointing a committee of men of science to make a report on the conduct of the Fish Commission during the past two and a-half years. The National Academy of Sciences is the legal adviser of the government on scientific questions, and a commission consisting of President Gibbs, Mr. Agassiz and President Jordan could make a report, the

conclusions of which would be final. It is our belief that freedom of thought and action and permanent tenure of office are so important for the advancement of science that no scientific officer, whether of a university or under the government, should be removed except on the ground of incompetence publicly proved.

President McKinley may, indeed, judge that incompetence in the present Commissioner has been publicly proved by his record prior to his appointment and by his conduct of the Commission, and if he has reached this decision it would be hard to question its justness. The appointment was unfortunate, as is admitted by every one; and while the Commissioner has since learned somewhat of the practical work of hatcheries, it does not appear that he is willing to take scientific advice in regard to the conduct of the Commission. It must also be remembered that the education of the Commissioner, as far as it has progressed, has been very expensive, costing the government perhaps as much as to train a hundred young men until they were competent to fill the position.

Apparently the efforts of the Commissioner have hitherto been directed to collecting the largest possible quantity of eggs in order that he may announce the numbers in his annual reports. Thus the last annual report states that 128,000,000 lobster eggs have been collected during the year, being an increase of 46,000,000 over the numbers for 1895. We are not, however, told how many of these eggs were killed at the hatcheries, and the Commissioner is probably not aware that in taking the eggs from the hen lobster he materially interfered with their chances of survival. Scientific research has demonstrated that the lobster in berry, whose capture is prohibited by law, can care for the eggs far better than would be possible in any hatchery. To collect them as is done is analogous to taking all the babies born in New York City and depositing them in a baby farm. It is true that much might be accomplished by collecting the eggs in regions where they are abundant and depositing the young where the lobster has been nearly exterminated; but the Commissioner states explicitely 'that he believes in following nature as closely as possible, by depositing the young on the ground from whence the eggs are taken.'

Even at present the Fish Commission is performing a useful work in some directions, such as the distribution of shad fry, with results that more than repay the entire expense to the government of the Commission. But it is now living, not on income, but on capital. The scientific knowledge of the development, life histories and habits of fishes acquired when the Commission was directed by Baird, by Goode and by MacDonald is being used, but not increased. The efficiency of the hatcheries and of methods of distribution cannot be advanced or even maintained, and it is impossible to extend the work in needed directions, as to the oyster. It would be ignoble to depend on the work of foreign nations and investigators, even were it directly applicable to the conditions of our coast. But, indeed, the present Commissioner has not the knowledge to 'convey' what he cannot

earn. It is reported that recently, when he claimed that the station at Woods Holl was the greatest biological station in the world because it hatched the largest number of fry, he was reminded of the Naples station, but replied that he had not heard of it.

The station at Woods Holl, made by Baird, Goode and MacDonald a center of research, fruitful in practical applications, regarded as a model by other nations, has now fallen into disrepute. The institution has been practically closed to investigators. The present Commissioner is apparently unable to appreciate what such a station means and what great practical benefit might proceed from it. Scientific research and the applications of science are but the obverse and reverse of the same coin, and he who expects to do without one side of the coin will find that he has none left in his pocket.

Now since the Coast and Geodetic Survey has been reformed by the present administration, only the Fish Commission needs its attention. When Mr. Cleveland was Governor of New York he vetoed the bill for the continuation of the Geological Survey of the State, and when President he occasionally showed that he had too long postponed his university training. The present administration is, however, in full sympathy with the scientific departments of the government, and is competent to decide whether the present Commissioner meets the requirements of the law, and, if not, to appoint a Commissioner of 'proved scientific and practical knowledge of the fishes of the coast.'

THE NATIONAL ACADEMY OF SCIENCES.

THE autumn meeting of the National Academy was held this year in Boston, beginning at 11 a. m. on Tuesday, November 16th, and continuing until Thursday afternoon. The attendance of members was unusually large for an autumn meeting, about thirty being present at one time or another during the three-day session. The absence of some members residing almost within sight of the place of meeting was a noteworthy indication of a lack of great interest in the leading scientific organization of the country. The program of papers offered was also unusually long and varied, nearly every department of science being represented. While all of these contributions were valuable and taken together represented a large amount of original investigation, none could be considered as unusually or unexpectedly important or strikingly novel in character or results.

The session opened with Professor Woodward's paper on 'The Mass of the Earth's Atmosphere.' The general conclusions of interest were that the radius of the atmosphere was probably five or six times that of the earth, and that while its mass could not exceed five per cent. of that of the earth it was probably not more than one millioneth as much. Professor Carl Barus presented the result of further studies of the effect of time on the temper of steel, the beginnings of which he had published some years ago. The lapse of years has served to bring out more clearly the interesting and important secular changes, the recent measurements having been made on the same specimens used in the earlier stages of the investigation.

This paper was followed by that of Dr. Mendenhall on 'Steel Knife Edges,' which was also a continuation of researches communicated to the Academy at previous meetings. The present investigation

consisted in the main of an examination of the behavior of steel knife edges under pressure and with varying angles. By observing the electrical resistance of the surface of contact of the pressure plate and the knife edge, the effect of pressures varying from zero to twenty thousand pounds was determined, the length of edge being about two inches. The superiority of the wide angle edges was clearly shown, confirming the conclusion reached in previous investigations. Professor O. C. Marsh next gave an interesting account of recent visits to the Russian museums, in which, greatly to his surprise, he found no examples of dinosaurs. He held, however, that they would yet be found in the district represented by these museums.

Professor Chittenden presented the results of an elaborate investigation of the effects of borac and boric acid on nutrition, and Dr. Minot, who was formally introduced as a new member by the President of the Academy, having been elected to membership at the April meeting in Washington, read an interesting account of embryological investigations in which he has been engaged. Professor W. A. Rogers gave the results of his last determination of the relation of the yard and meter, depending upon a recent comparison of his own standard with one of the new prototypes in the Office of Weights and Measures at Washington. Professor Morse presented important results of the study of the ancient molluscan fauna of New England and Professor Verrill discussed cannibalistic selection as a factor in evolution.

The session on Wednesday morning was devoted to the transaction of business, members only being admitted. The important event of the session was the formal acceptance, by the Academy, of the gift of $20,000 from Miss Alice L. Gould, daughter of the late Dr. B. A. Gould, one of the charter members of the Academy. Miss Gould had communicated her intention of making this gift in honor of the memory of her father and of his long connection with and interest in the National Academy, at the April meeting in Washington, but on Wednesday the deed of gift was formally presented, together with the conditions on which it was made and the names of the first trustees. Its acceptance was authorized by the Academy and the trust assumed. The income of the fund is to be devoted to the encouragement of astronomical research and its management is to be essentially like that of the Bache fund. The trustees selected by Miss Gould were Professor Boss, Dr. S. C. Chandler and Professor Asaph Hall.

In the scientific session that followed, Professor Hyatt reported progress in an interesting study in which he is engaged, upon the migration of land shells on the Hawaiian Islands. The material for this study had been obtained from an extensive collection of shells made by Rev. J. T. Gurlick while a missionary in the islands thirty or forty years ago. This collection had been so systematically made and the locations so carefully noted that Professor Hyatt was enabled to lay out on a relief model the various localities occupied by different species, and to indicate the paths along which their migrations must almost certainly have been directed.

This paper was followed by an exhibtion by Professor Michelson of his new harmonic analyzer, which he had brought from Chicago to show to the Academy. In the latest form of the machine eighty elements were included, and it appeared to be capable of producing results correct to within about one per cent. The machine was put in operation, and its work, both in analysis and synthesis, was greatly admired. Mr. C. L. Norton presented by invitation a description of new apparatus, one for thermometer comparisons and the other for determining the heat of combustion.

A paper by Dr. Weir Mitchell and Alonzo H. Stewart, on the 'Action of Venom of Crotalus Adamanteus Upon the Blood,' was read by Dr. Bowditch.

On Thursday there were further contributions by Professors Verrill and Marsh. Professor Cross, on invitation of the Council, presented a paper on the 'Wave Siren,' and S. C. Chandler discussed the agreement of 'The Theory of the Motion of the Pole with Recent Observations.' There was also a paper by Major Powell, 'An Hypothesis to Account for Movements in the Crust of the Earth,' and Professor Emmons gave an account of the International Congress of Geologists at St. Petersburg.

As might well be expected, the social features of a meeting of the Academy were not lacking. A number of academicians availed themselves of the opportunity to hear the last of the course of lectures on 'Tides' by Professor George Darwin, at the Lowell Institute, the final lecture of the course being on Tuesday evening. There was unusual interest in the reception on that evening, at the home of Mrs. Professor W. B. Rogers, whose husband was for several years and at the time of his death the President of the Academy. Similar courtesies were extended to members on Wednesday and Thursday afternoons, and on Wednesday evening Professor Trowbridge described and exhibited his new 10,000-cell storage battery and high-voltage apparatus.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

THE 18th annual and 36th regular meeting of the American Society of Mechanical Engineers was held in New York, beginning on November 30th. This Society, now seventeen years old, numbers nearly two thousand members, including substantially all mechanical engineers of the United States. Its transactions are always rich in valuable technical facts and data and are usually so extensive as to fill a large annual volume.

The principal papers of the present session were the following:

Mr. F. W. Dean summarizes the progress of improvement in reducing the 'Cost of Steam Power' from 1870 to 1897; showing that the gain has been between thirty and forty per cent. He attributes this saving to the following: 37% to higher steam-pressure and ratios of expansion, multiple-cylinder engines, steam jacketing and drying or superheating the steam; 5% to the use of vertical engines; 7% to improved boilers; 7% to economizers heating the feed water; 2% to improved grates. The weight of steam used per horse-power per hour has fallen from 20 to 12.5 pounds, as minima for the dates given. He finds the compound engine the usual and on the whole most successful form of engine and gives valuable data relating to its efficiency and the costs of power where it is employed.

Professor Carpenter presents the results of 'Tests of Centrifugal Pumps' and 'Calibration of a Weir' at Chicago, where the unique opportunity was presented of making such determinations on an exceptionally large scale, and of checking the standard formulas for discharge perhaps more accurately than ever before on anything approaching so large a scale. The conclusion is reached that the Weisbach formula is more exact than the Francis, under such circumstances, and that it is best employed without allowing for 'end-contraction.' The great centrifugal pumps, of usual form, gave efficiencies rising to above 60 per cent.

Dr. Thurston, in conjunction with Mr. Brinsmade, read a paper on 'Multiple Cylinder Engines and Effects of Variation of Loads,' in which the experimental investigation of the relative efficiencies at various loads was determined for the standard 'compound' and 'triple expan-

sion' engines and for the peculiar form of engine produced by omitting the intermediate cylinder from the latter, thus producing a machine with abnormally high ratio of cylinder-volumes, as successfully employed by Rockwood. A wide range of load was adopted and the result is found to be an efficiency, in the case of the novel form of engine, intermediate between that of the triple-expansion and that of the standard compound, approaching the efficiency of the latter as maximum expansions and minimum loads are approximated. We may be able to give later a fuller abstract of this paper.

Mr. W. S. Keep details a series of experiments upon 'Cast Iron under Impact,' in which he shows some very singular and puzzling phenomena, such as the increase of the strength of the metal by simply smoothing its surface, variation of the resistance and of the elastic limit by such alterations of its superfices, and similar hitherto unsuspected modifications of its molecular characteristics by this method of strain.

Mr. George Richmond offers a study of 'Thermodynamics without the Calculus,' in which he develops in an interesting and peculiarly helpful manner the method of Professor Gibbs in the application of the temperature-entropy system of coordinate, thermodynamic geometry. The paper is presented in compliance with the request of members of the Society in the course of a discussion during the preceding meeting.

Mr. Charles T. Main gives a very unique paper, on the 'Valuation of Textile Manufacturing Property;' which important but greatly neglected department of technical literature has peculiar interest to the capitalist and the economist as well as to the engineer. This study is in great detail, and its writer is an acknowledged expert.

Mr. Fletcher submits an account, given by the inventor, who is still living at a ripe old age, of the invention and introduction of the Stevens Valve-Gear for steam engines, universally employed for many years past on the 'American river-boat engine.' It is an interesting and valuable contribution to technical history.

Other papers, numbering in all over twenty, are contributed by as many members, each expert in his own department, and affording material for another valuable volume of transactions.

The next meeting will probably be at Niagara Falls.

PRESIDENT GILMAN ON THE RELATIONS OF SCIENCE AND COMMERCE.

At the annual banquet of the Chamber of Commerce in New York, November 23d, the chairman, Mr. Alexander E. Orr, called upon President Gilman, of Johns Hopkins University, to respond to this sentiment, *Commerce the Child of Science and its filial Supporter*. The substance of Mr. Gilman's remarks is indicated in the following report:

Let me give some striking illustrations of the impulse that Commerce has received from Science; but let them all be drawn from present times, at least from days with which many men in this assembly are personally familiar.

Without astronomy there could be no sure navigation of the open sea. The great observatories, with their able masters and their powerful lenses, are revealing to human intelligence the celestial mechanism, and are making every year more accurate the nautical almanacs—those guides to the heavens, so sure and so important that we may almost call them 'The Pilots' Bible.' It is to the science of naval architecture that commerce owes the marvelous improvements which have transformed the packets of the 'Black-ball' line and the Baltimore clippers into the iron steamers of to-day. The size, materials, forms, structure, of sea-going ships, both men-of-war, protectors of

commerce and the great liners of the ocean, are the results of careful study, by able men in quiet hours, devoted to the ascertainment of accurate knowledge.

It is the science of mechanics which has developed the steam engine for the feeble motor, plied by Fulton on the Hudson, into the triple and quadruple expansion engines which now propel these enormous steamers, to and fro, across the ocean, with a regularity almost as sure as the swinging of a pendulum.

Geographical science has studied every portion of the globe and opened to commerce the continents of Africa and Australia, and the islands of Japan and Oceanica, closed to Europeans before the days of Wilkes, Perry, Stanley and other explorers.

It is to hydrography that commerce owes the accurate surveys of coasts, channels and harbors, initiated in this country by the Blunts, those once famous New Yorkers, and those surveys of the ocean depths which made possible the laying of the Atlantic Cable.

Physics has well fulfilled its part by the improvements introduced into the construction of the mariners compass, the propelling screw, the perfection of light houses, the introduction of fog signals, and the ever advancing development of electro-magnetism, most significant, far reaching, revolutionary and serviceable of all modern discoveries.

Meteorology, a branch of physics, grows more accurate every year and is interpreting and foretelling the course of winds and cyclones.

Almost all these advances lie in the field of mathematics.

Cancel these gifts of science. Restore electricity to the excitement of a bit of amber, bring back the quadruple expansion engine to the tea-kettle from which it has been evolved, reduce the nautical almanac to a deliniation of 'the Dipper,' and destroy the charts on which reefs and shoals are carefully indicated to the rude outlines of even fifty years ago—and where would commerce be?

Now let us change our point of view and see how these obligations have been met. With open-handed munificence, with horns of plenty filled with the products of every clime, Commerce, the child of Science, has been her generous supporter. Rapidly glance at the record.

It was an East Indian merchant

> Born in America, in Europe bred,
> In Africa travelled and in Asia wed

made those gifts to the collegiate school in New Haven, which have given renown for almost 200 years to the name of Elihu Yale. The last half century has been prolific in kindred gifts. It was a merchant of Mobile who founded the Sheffield Scientific School in New Haven; a merchant of Boston who gave his name to the Lawrence Scientific School in Cambridge; a merchant of New York who established the John C. Green School of Science in Princeton; a merchant of Brooklyn whose gifts to Cornell University surpassed the founder's; a business man of Philadelphia who founded the Towne School of Science; a merchant of New Orleans whose name is recalled by Tulane University; and a merchant of Baltimore, Johns Hopkins, who divided his fortune between a university and a hospital.

Just so with modern libraries in this country. John Jacob Astor, a merchant of New York, set the example, soon to be followed by Lenox and Tilden. Joshua Bates, a partner of the Barings, rendered a like service to Boston, and William Brown, one of the Brown Brothers, to Liverpool. The museums at Cambridge and New Haven attest the scientific interest of George Peabody, who founded a library in Baltimore. Chittenden, of New York; Pratt, of Baltimore; Newberry, of Chicago, each one a mer-

chant, and a great many more, are the builders of libraries, which Carlyle once called 'the true universities.' When Western learning is needed in Turkey and the Levant, it is a merchant of New York who founded Robert College, near Constantinople, and another merchant, William E. Dodge, and his associates, who established the Syria College of Beirut. When it was a question of Arctic research Henry Grinnell and George Peabody equipped the expedition of Kane and his successors, and when a museum of natural history was required, or a gallery of fine arts, it was from the members of this chamber that support was secured. Thus commerce generously has contributed to the maintenance of learning. Is it not that the pursuit of commerce broadens the mind? To promote among the nations of the earth those exchanges which benefit alike the buyer and the seller enlarges human sympathy. The study of the world's resources, requirements and conditions of prosperity produces wisdom, courage, forethought and generosity.

PRIMITIVE MAN IN THE DELAWARE VALLEY.*

INTRODUCTORY.

A FEW years ago, as a result of extended explorations, conducted by the Bureau of American Ethnology, questions were raised with reference to the soundness of the then existing evidence relating to glacial man in the Eastern States, and the correctness of the conclusions drawn from it. Since that time, until quite recently, investigation has progressed slowly and but little has been brought forward likely to change the status of the case. Now, however, strong claims are being made of the discovery of new and confirmatory evidence of antiquity, and discussion is invited with a view of determining its merits; but before taking up this phase of the subject it is desirable that the earlier phases of the investigations be passed briefly in review.

*Read at the Detroit meeting of the American Association for the Advancement of Science.

The questions raised by me were not those of the age of man in America. I have always taken the view that the race must have occupied this continent for a very long period. Great antiquity is clearly proved by facts derived from other than archæologic or geologic sources. It does not require argument to show that the development of many well differentiated nations and tongues means a prolonged occupation. It does not take argument to demonstrate the proposition that, notwithstanding the potent influence of local environment upon human art and effort, a thousand distinct cultures could not spring up in a day.

The only questions I have ventured to discuss and the only ones that now claim my attention are as to whether the evidence already brought forward to demonstrate the antiquity of man on the Atlantic slope will stand the test of scientific scrutiny. There is a record of man in the valleys and among the hills throughout the entire country. There is an important record in the geological formations of the Delaware valley. Has the key to this record been discovered? Has the true combination been worked out, or are our pioneer investigators struggling through a phase of this particular research corresponding to that encountered by the predecessors of Champollion in the reading of the Egyptian hieroglyphs? The earlier readings at Trenton seem to indicate possibly three distinct peoples and periods of occupation, referred to by some as paleolithic, Eskimo and Indian; but are we sure of more than one and are the others mere figments of the imagination? Time will tell, but this year or the next may not finally decide it.

THE ALGONQUIAN OCCUPATION.

The first step in acquiring a knowledge of the past is to seek to understand the present. An acquaintance with the historic peoples of a region is the best key to the prehistoric peoples. In the study of the question at issue in the Delaware valley correct method demands that we look first to known conditions for explanations of all doubtful phenomena. The only occupants of this region known to us were a group of Indian tribes of what has come to be known as the Algonquian stock. The history of these tribes, as dimly shadowed forth by tradition and archæology, extends back indefinitely into the past. They were found by the whites living in villages, cultivating corn, navigating the waters, hunting, fishing and warring; weaving simple fabrics, practicing the potter's art in its most primitive form, and employing stone as the chief material for implements and weapons. They used metal to a very limited extent and employed shell, bone and wood in various arts. Their culture status is made clear by actual observation of the peoples themselves, as well as by a study of the relics of many village sites known to have been occupied by them. The local tribes, the Leni Lenape, had relatives of like culture extending along the coast from Carolina to Maine and from the mouth of the St. Lawrence to the head of the Great Lakes. They had neighbors of other stocks, all occupying about the same simple level of neolithic culture. Researches long continued in the whole vast territory occupied have developed no definite trace of other people or other conditions of culture. No one can say how long they had been here or whence they came, but their coming was doubtless long ago. Wandering bands pushed their way over the hills or along the shores and gradually took possession of this beautiful region. One group, known to us as the Delawares, occupied the Delaware valley, adopting it as a permanent home. Their dwellings were established along the banks of the rivers and creeks; they multiplied and spread, and, being an active and enterprising race, gradually acquired a knowledge of the resources of the country, and especially of the varied mineral products, which were of the utmost importance to their welfare. On local sites they worked the varieties of stone available for implements. They dug them out of the loose deposits of the stream beds and bluffs. They advanced into the hills and mountains, and little by little discovered the deposits of desirable rock in place, and quarried deeply into the bowels of the earth. The work of search and exploration was so thorough that nothing escaped them, and the archæologist looks with amazement on the still existing evidences of their energy in quarrying argillite, jasper and soapstone.

The stones available to such a people in the earlier periods of their occupation would be the loose cobbles and masses of the rivers and bluffs. In the Trenton region the only material well fitted for flaking—the chief shaping process of the early days—was argillite, a compact slaty-looking rock especially plentiful in some parts of the glacial gravels. It follows that on and about the margins of the glacial terraces flaking at first dealt chiefly with this material. The beds of argillite found in place farther up the valley would next be utilized and later the flints and jaspers of the distant uplands would be discovered and used. How long it was from the time of the first occupation to the period of complete exploration and utilization of resources thus outlined no one can guess. It may have been 500 or it may have been 5,000 years. During this prolonged period the work of shaping stone implements went on. The raw material was sought and worked up with a persistence and energy that might

almost be regarded as a foreshadowing of the vast mining and manufacturing industries of to-day. The knives, scrapers, drills, projectile points, etc., the implements upon which everything in the savage economy depend, were roughed out, specialized and carried away, and the refuse in vast quantities, consisting of flakes, fragments and failures representing all stages of development, was left upon the ground. The rejectage must have been especially plentiful along the bluffs at Trenton, where the argillite was found in the shape of bowlders and partially worn masses, and in the valleys and hills above, where it occurs in place. The rude rejected forms left upon these sites were large or small, long or short, according to the shape of the implement made and the nature of the material used. They were rough or well developed according to the stage of the shaping process at which they were cast aside. No type of flaked stone has been found in the whole region that was not necessarily produced again and again and for centuries along the banks and bluffs of the Delaware by these historic peoples, and in the course of years and geologic mutation it is readily seen that this rejectage of implement-making would become intermingled in various ways with the superficial deposits of the sites of manufacture. Every bank that crumbled, every grave dug, every palisade planted, every burrow made, every root that penetrated and every storm that raged took part in the work of intermingling and burial; and following in turn came the resettling, the leeching-out and the recementing of these deposits, making it difficult to distinguish the old from the new. It follows, therefore, that the student of the history of this valley, and especially of that part of it recorded in the soil and superficial deposits, should not for a moment lose sight of these conditions and events of recent and comparatively recent history, and should seek first to explain all phenomena from the point of view thus afforded before conjuring up shadowy images of other races.

INVESTIGATION IN THE GLACIAL GRAVELS PROPER.

It happened, however, that before the investigation of the phenomena referred to above and now so definitely assigned to the Algonquian peoples had begun to attract the attention of archæologists the presence of other people had already been assumed. Evidences of very primitive paleolithic races had been associated with glacial formations abroad, and the glacial deposits of the Delaware region were accordingly searched with the hope of finding similar traces. Relics of art were soon secured, and as they were rude and exclusively of flaked stone they were regarded as supporting the theory of a glacial paleolithic man. A large body of evidence was soon accumulated and passed into literature without particular scrutiny.

When, finally this subject came into prominence and questions began to arise as to the determinations made, it was found that the flaked stones which formed the exclusive evidence furnished, though rude as reported, were not of special or peculiar types, such as seem to characterize paleolithic times abroad, but that they corresponded in every particular with the ordinary rude work, and especially with the rejectage of manufacture, of the Algonquian and other American tribes; and it happened further that they were found along the very bluff faces where argillite bowlders outcropped and where the Indian tribes had naturally resorted to secure the raw material and block out their implements; then it came to be asked whether the finds had really been made in the true gravels, whether they were not obtained from deposits associated with the gravels but not belonging, in their present deposition, to

the glacial age; such deposits as accumulate in depressions, or along the faces of bluffs and banks subject to crumbling and sliding. When later it was realized that the questions involved, the nice discriminations to be made in collecting this evidence, were really geologic rather than archæologic a new phase of the investigation was initiated and geologists were asked to participate in the examinations. It was imperatively demanded that the gravel should be reexamined and the evidence sifted and placed on a safe footing. In meeting this demand for re-examination of their evidence the advocates of an American paleolithic man have claimed that the criticisms made were to be classed with those encountered by Boucher de Perthes when he began to present his evidence regarding early man in Europe; that such criticisms meet every advance of thought. But the cases are by no means parallel. The discoveries of Boucher were not acceptable because of their revolutionary character with respect to accepted beliefs. On the other hand, the Trenton determinations were popular and almost universally accepted as final until attention was called to the true nature of the objects found, and especially to the unsatisfactory methods pursued in collecting evidence. The climax came when it was understood that the advocates of a glacial paleolithic man were gathering all classes of rudely flaked stones from the surface of the country generally (entirely disregarding an Indian occupation) and employing them to establish a peculiar theoretic culture for America.

It was not conservatism, and especially it was not conservatism in religious thought, that led such men as Powell, Brinton, McGee, Chamberlin, Salisbury, Mercer, Mason and others intimately acquainted with the field of investigation to seriously question the methods and the evidence. The charge of conservatism must rather be urged against

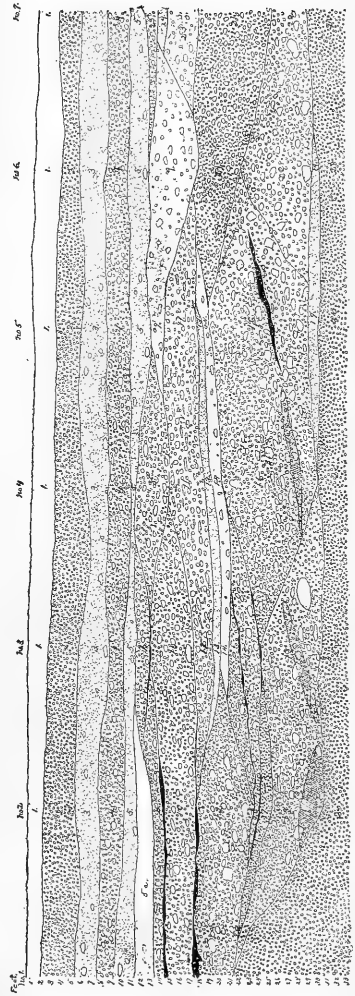

FIG. 1. Section of the Trenton gravels showing relation of productive to non-productive profiles.

those students who have held to their original views and especially against such scholars as Topinard, Boulé and Keane, who accept without serious scrutiny any evidence that tends to confirm accepted theories with respect to a uniform history of the race on both sides of the Atlantic.

Fortunately opportunities for a re-examination of the evidence have arisen in several cases. The principal discoveries of shaped stones attributed to the gravels were made in the slope of the bluff facing the river at Trenton (*A* in the section, Fig. 1) and in the banks of Assanpink Creek at the point where the Pennsylvania railway makes its way from the station near the creek level to the terrace above (*B* in the section). Finds continued to be made in the crumbling river bank at *A* until accumulating city refuse covered up the deposits.

They ceased to be made in the creek banks at *B* as soon as the cutting extended fairly into the gravels in place; and when, in 1889, I asked the principal explorer of this locality why the finds had ceased, he replied that when the railway cutting was made the excavations were carried up through a depression that must have been an old stream bed, and that the finds were in the filling of this channel. I do not think he understood the significance of the admission, but the statement must have been true, as nothing whatever is to be found in the present excellent exposures of the true gravels. The position of his finds are indicated at *d* on the dotted original profile in the section, and the present utterly barren exposures, half a mile or more in length, are indicated at *e*.

Identical results have been reached on the river front *A*. In 1892 a great sewer trench, *C*, 33 feet deep, was cut, parallel with the river bank, at the very point where so many shaped stones had formerly been found. Though we kept up the search in this trench for five weeks as the work of excavation went on—the whole body of gravel being subjected to rigid examination—not a chip was found, not a trace of man. No other examination has been made that compares with this for thoroughness and length of time involved. The evidence thus furnished has been spoken of as negative and hence as unsatisfactory, but, in the continued absence of finds of implements at this and other points, it seems positive and convincing. The conclusion reached is that there must have been an error in the observations that could produce hundreds of flaked stones from obscure or partial outcrops at a given spot in a crumbling bank when not a trace can be found at the same point when the beds are fully exposed.

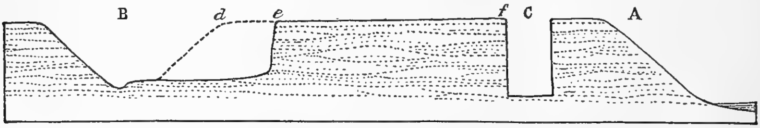

FIG. 2. Portion of section of gravels exposed in sewer trench, fac-simile of the original notes by Mr. Wm. Dinwiddie.

Geologists will be interested in seeing the detailed section made by my assistant in the trench. It tells the story of the deposits better than any other section that has been or probably ever will be made.

Considering the foregoing facts, it may be regarded as substantially proved that the glacial gravels proper contain no relics of art, and it would appear that now very few persons, indeed, expect them to yield any evidence whatever on the subject of human occupation. Five years have passed since the earlier observations and finds.

were challenged, and in that time, so far as I have learned, no single implement has been reported from the gravels, although the exposures are as extensive as they ever were. The first chapter in the prolonged search for glacial man at Trenton may, therefore, be regarded as practically closed; but some new evidence furnished by examination of certain superficial deposits of sand come up for consideration. My remarks upon this subject will appear in a subsequent number of SCIENCE.

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ON SOME IMPORTANT SOURCES OF ERROR IN THE PLANKTON METHOD.

THE Hensen method of plankton collection consists essentially in drawing a silk net vertically through the water. A part of the column of water traversed by the net is pushed aside, hence the actual catch must be multiplied by some factor to obtain the amount of plankton present in the given column of water. This factor, 'the coefficient of the net,' has been calculated by Hensen, for a series of velocities, from empirical data, and is applied uniformly to all catches without regard to the character of the plankton. The coefficient of the net used at the Illinois Biological Station, according to Hensen's formula, is 1.32 (velocity 0.5 meter per second). A series of field tests in which a column of water, similar to that traversed by the net was pumped and strained, indicates that the coefficient of the net varies with the amount and constituency of the plankton, ranging in the case of our net from 1.5 to 5.7. This variation is, in part at least, due to the increased clogging in the case of heavy planktons. The effect of the progressive clogging upon the coefficient is shown in a series of horizontal hauls of 5, 10, 15, 20 and 25 meters, which were made successively in similar water. The coefficient rose from 1.5 in the 5-meter haul to 4.83 in the 25-meter haul. A comparison of 15-meter hauls with those of 30 meters indicates that from 84% to 96% of the 30-meter catch is taken in the first 15 meters of the haul. Four places of decimals in a computed coefficient can hardly offer compensation for an error so fundemental as the variation in the straining capacity of the net. This error can be avoided by adoption of the pumping method and straining of a known quantity of water.

The plankton method as elaborated by Hensen and others depends upon the efficiency of the finest silk bolting cloth in removing the contained organisms from the water which it filters. It has been accepted by planktologists that the use of this cloth furnishes a satisfactory basis for the volumetric determination of the plankton and the enumeration of its constituent organisms. Hensen* (p. 75) states that the openings in the silk are so small that not many organisms can pass through them. Apstein† (p. 235) says: "With nets of this cloth almost all organisms are caught, only a few diatoms, which happen to meet an opening with their long axis, escape." Again‡ (p. 35) he maintains that almost all organisms are removed from the water by the use of No. 20 bolting cloth. No protest has been raised by our American workers§ || to these claims of the founders of the plankton method. The leakage of the plankton through the silk has thus been minimized or ignored, and without tests of the extent to which it occurs.

* V. Hensen. Methodik der Untersuchungen bei der Plankton-Expedition. Kiel und Leipzig. 1895.

† C. Apstein. Uber die quantitative Bestimmung des Plankton in Süsswassers: in Die Tier- und Pflanzenwelt des Süsswassers. Dr. O. Zacharias. Leipzig. 1891.

‡ Das Süsswasserplankton. Keil und Leipzig. 1896.

§ J. Reighard. A Biological Examination of Lake St. Clair. Lansing. 1894.

|| H. B. Ward. A Biological Examination of Lake Michigan. Lansing. 1896.

The bolting cloth (No. 20), when new, contains from 5,100 to 5,600 meshes per square centimeter, varying with the maker and the sample; when thoroughly shrunken the number of meshes increases as much as 30%. The total area of the openings in a square centimeter, on the other hand, decreases over 50%, falling from .133 to .066 sq. cm., and the average area of a single opening is reduced from .000024 to .00001. sq. cm. This latter figure represents an area of $32 \times 32 \mu$, the average area of the openings at the maximum efficiency of the silk. These dimensions do not, however, constitute a precise limit to the size of objects which can escape through the openings, for many meshes exceed this area, and some even double it. The struggles of the imprisoned organisms and the pressure of the filtering water also materially assist the escape of the planktonts through the yielding meshes of the silk.

For the past year and a-half the leakage of the plankton through the silk has been a subject of experiment at the Illinois Biological Station. The results were at first so surprising as to require the most careful corroboration, and they have been witheld from publication in the hope that an adequate remedy might be offered therewith. Water from a number of sources, collected at different seasons of the year, and containing plankton varying in amount and constituency, has been subject to examination in several ways, and their relative efficiency determined by the Sedgwick-Rafter counting method. In order to reduce the error incident to this process, the enumeration of the planktonts was extended over from five to ten times the customary fraction of the catch. The leakage has been tested as follows: by the Sedgwick-Rafter sand filter; by hard-pressed filter paper; by the centrifuge, and by the Berkefeld filter. The silk catches were made from measured quantities of water, thus eliminating the uncertainty as to the amount of water which the drawn net filters. Tests were made of the filtrate from the silk, and also of the unfiltered water. Owing to diversity in the constituency of the plankton, the ratio of efficiency of these various methods cannot be precisely stated. In a general way the order above given is that of increasing efficiency. The silk, *in the pumping method of collection*, retains from 5% to less than 0.1% of the total *number* of organisms present (excluding bacteria), as contrasted with the catch of the Berkefeld filter.

The Sedgwick-Rafter sand filter was used according to the published directions of Calkins,* and later of Jackson† and Whipple‡. This method is far more efficient than the silk, but proved to be subject to considerable loss, especially in the case of water richly charged with plankton. Not only do the minute forms, as *Raphidium* and the smaller diatoms, readily slip through the sand, but also the more active species, as *Euglena* and *Trachelomonas*, escape in considerable numbers. Examinations of the filtrate from the sand revealed the fact that this method captures from 40% to 65% of the number of organisms present, the greater losses occurring with abundant planktonts.

The filter paper employed was No. 575 Schleicher & Schüll. It is very free from lint and does not easily tear when wet. As the filtering proceeds the plankton is condensed in the bottom of the funnel by means of a fine spray from a hand bulb. When the required condensation is reached the plankton can be washed from the paper by the

*G. N. Calkins. The Microscopical Examination of Drinking Waters. 23d Ann. Rep. Mass. Board of Health, for 1891.

†D. D. Jackson. On an Improvement in the Sedgwick-Rafter Method. Technology Quarterly, Vol. IX. 1896.

‡G. C. Whipple. Experience with the Sedgwick-Rafter Method. Ibid.

same means, care being exercised in removing the plankton quickly and thoroughly to reduce the loss occasioned by its adherence to the paper. This method is very simple, rapid, and, in my experience, more efficient than the sand filter, yielding from 75% to 85% of the planktonts.

The centrifuge at first employed was a small one having a capacity of 60 c. cm. Later, we had constructed for this work a large machine geared to give 3,000 to 4,000 revolutions per minute and arranged to act upon a continuous stream of water, all of which was subjected to the maximum and uniform action of the centrifugal force. This machine is more efficient than the filter paper, securing in some instances 98% of the planktonts. It is, however, subject to a selective error, in that the individuals and species whose specific gravity is the same as or less than that of the water are not removed by the action of the centrifugal force. Samples rich in water blooms proved to be most troublesome. *Anabœna* and *Clathrocystis*, as a rule, and many individuals of other genera, as *Euglena* and *Chlamydomonas*, readily pass through the machine. Water kept in the dark, or at low temperature, for some hours yields up such plankton more readily. The addition of alcohol to the water also facilitates precipitation. The most accurate results, however, were obtained after adding chloral hydrate to the water in quantities sufficient to kill the plankton. The selective character of this error, and its consequent uneven distribution in plankton varying greatly in the abundance of water blooms with the season and situation, render the use of the centrifuge of questionable utility as a basis for a complete analysis of the biologic contents of water.

The cylinders of the Berkefeld filter are made of 'infusorial earth' of such fineness as to remove effectually all solid matter from the water passing through them. The smallest cylinders were encased in a suitable mantle and attached to the centrifugal machine. The catch obtained in this manner contained from one-fourth to one-third more organisms than that of the filter paper, and was not subject to the irregularities resulting from the use of the centrifuge. This preliminary test was so promising that a larger form of the Berkefeld filter, known as an 'army filter, System Bruckner,' which has of late been introduced in the German and Austrian armies, was tried as a means of collecting plankton. It has the following advantages: its maximum capacity under favorable conditions is about two liters per minute; it is portable and can be used in the field; its simple construction favors the removal of the catch, and its capacity for filtration can be quickly renewed when it becomes clogged. At present it seems to offer the most effective method for the collection of the plankton which eludes the silk. It is, however, subject to one serious drawback; the removal of the catch from the filtering cylinder is accompanied by the addition of a considerable amount of the infusorial earth to the plankton. This renders the 'Danaid task' of counting doubly difficult and precludes volumetric determination. The desideratum for a filtering cylinder for this work is yet to be found. It should be an inexpensive porous earthenware cylinder whose outer surface is of sufficient fineness to preclude the penetration of minute organisms, and of a firmness sufficient to permit the removal of the catch with a stiff brush without disintegration. Experiments in this direction are now in progress.

This leakage of plankton through the silk is a matter of fundamental importance. A considerable volume of the contents of the water is lost at all seasons of the year, and in some instances the actual catch of the silk net is but a small fraction of the total plankton present. Filter-paper catches from a

variety of situations made at intervals throughout more than a year indicate that the silk net retains from one-half to one forty-fifth of the total solid contents of the water, the greater losses occurring from waters containing *Trachelomonas*, *Chlamydomonas*, *Euglena*, *Melosira* and other minute forms in abundance. The relative amount of silt is, however, much greater in the filter-paper catches than it is in those made with the silk, so that the actual volume of plankton lost is less than the above figures indicate. The amount escaping through the silk bears no constant relation to the amount retained. Under these conditions the volumetric determination of the plankton by the use of the silk net as a test of the productiveness of water is not only incomplete but may be misleading.

For the examination of the plankton by the statistical method the silk affords a satisfactory basis only for the larger forms, such as the *Entomostraca* and the larger *Rotifera* and *Protozoa*. For the smaller and often very abundant planktonts, such as *Melosira*, *Peridinium*, *Dinobryon*, *Raphidium*, *Scenedesmus Euglena*, *Trachelomonas* and *Chlamydomonas*, the Hensen method is wholly inadequate. For example, from water in which these smaller forms were not extremely abundant the silk retained organisms to the number of 248,200 per cubic meter, while the catch of the Berkefeld filter indicated the presence of 767,556,000 planktonts in the same amount of water. Many of the organisms listed in the counting tables of Apstein may in reality escape in large numbers through the silk. Thus, of *Codonella* as many as *twenty-one* individuals may escape to *one* retained. The Hensen method must be supplemented by a more accurate system of collection if a complete census of the water world is to be taken.

From the œcological point of view the plankton lost by leakage through the silk s of prime importance, for it is composed very largely of minute algæ, which constitute a fundamental link in the cycle of aquatic life. Any attempt to unravel the complex interrelation of the constituents of the plankton or to correlate its ever-progressing changes with the factors of its environment must be based upon reliable data. Biological theory and aquaculture alike demand improvement in the plankton method.

The errors enumerated above are doubtless exaggerated by the situation with which we deal—waters rich in plankton and more or less turbid with silt. The tests, however, cover a considerable seasonal and local range of quantity and constituency, and have been made in both clear and turbid waters. The plankton, moreover, is composed very largely of the same genera as those found in the lakes in which Apstein and Zacharias have carried on their investigations, and over 50% of the species are identical. The desirability of experiments in other waters is at least suggested.

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SOUTHERN STAR-CLUSTERS.

THE last of the great contributions of Benjamin Apthorp Gould to astronomy is contained in the large volume recently published under the title *Cordoba Photographs: photographic observations of star-clusters from impressions made at the Argentine National Observatory*. This work gives the measurements of the relative positions of nine thousand stars included in thirty-five clusters of the southern heavens and in the Pleiades and Præsepe.

In addition to the other large enterprises which constituted the regular work of the Argentine Observatory, over twelve hundred plates of southern clusters were secured (no important one being omitted) in the decade beginning in 1872, of which 281 have been measured and 177 are now computed. Inasmuch as the dry plate pro-

cess was not available until more than one half of the plates had been secured (in 1881), the serious character of the task of merely obtaining the photographs, with all the difficulties of the wet process, is sufficiently apparent. But this labor was small relative to that of the subsequent measurements and computations, which were carried out rigorously in all respects during the past fifteen years. As for the work at the micrometer it is stated that two assistants, alternately measuring and recording, could ordinarily measure from thirty to thirty-five stars a day.

It is, indeed, unfortunate that it was necessary that so long a time should elapse before the publication of the results, for it has delayed the recognition of Dr. Gould's position as the leading pioneer in the application of photography to astronomy of precision. It should be recalled that it was necessary for him to solve for himself, or with the coöperation of his friend, Lewis M. Rutherfurd, most of the difficulties of adjustment, measurement and computation, which have since engaged the attention of frequent congresses of the committee of the *Carte celeste.* It was as early as 1866 that Dr. Gould presented to the National Academy his memoir on the reduction of photographic observations, with the determination of the position of thirty-nine stars in the Pleiades, from measures by Rutherfurd on plates he had taken. It is much to be regretted that the publication of this memoir did not occur until twenty years later.

On going to Cordoba in 1870 Dr. Gould carried with him the photographic object-glass which Rutherfurd had so successfully used, but to his dismay he found it had been broken on the voyage. Thus the work was delayed three years, although a hundred plates were obtained with the mended objective, then replaced by a new one. Two exposures, of about eight minutes, were made upon each plate, a slight shift in right ascension intervening, so that defects on the plates could be distinguished from stars; then a third exposure gave either a trail or one point of the trail before the star left the photographic field of view, whereby the orientation of the plate could be determined. Of course, great difficulty was found in securing accurately circular images, especially as the modern plan of a large guiding telescope was not employed, but 'plates not satisfactory in this respect were summarily rejected without hesitation, no record being made of them, or numbers assigned.'

The measurements were carried out with two micrometers constructed by Rutherfurd and used by him in his early work. The coordinates measured were position-angle and distance, referred to some selected star as center. In some cases, of large clusters, several centers were employed, but the final positions are in all cases reduced to differences of right ascension and declination ($\Delta\alpha$ and $\Delta\delta$) from a single central star. As each plate contained some stars whose position had been determined with a meridian circle, the comparison of the catalogue and photographic coordinates furnished equations of condition from which corrections were applied to the latter. The accordance of the separate determinations of $\Delta\alpha$ and $\Delta\delta$ on different plates is highly satisfactory, and is not exceeded in recent measurements of clusters by other astronomers provided with telescopes and measuring micrometers of the latest design. Were such confirmation longer necessary, the reliability of the photographic method would be sufficiently established by the results of this volume.

Dr. Gould expresses the 'fear that trustworthy inferences from stellar photographs may not be expected in the present condition of science and the photographic art,' and hence does not attempt to utilize the photographs for photometric purposes, although approximate magnitudes are as-

signed and discordances noted. It may be, however, that the plates will later prove more useful than was anticipated in this direction. Certainly a comparison would be interesting with the Harvard Arequipa plates, on which Bailey has detected numerous variable stars, and the periods of some might thereby be accurately fixed.

A chapter of the work, in parallel Spanish and English, is devoted to each cluster, furnishing all the necessary data of measurement, the relative positions, and comparison with other, visual, measures where existent. Excellent charts are given of all the clusters. At the time of the lamented death of Dr. Gould, a year ago, one-half (pp. 248) of the volume had been printed, and the computations of the remainder were practically complete. But the unfinished portion of the manuscript has been carefully prepared after the original plan by Mr. G. E. Whitaker, to whom Dr. Gould makes acknowledgment for ten years of efficient service, under the general supervision of Dr. S. C. Chandler, and the whole volume may be fairly 'regarded as coming complete from the hand of its author.'

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CURRENT NOTES ON PHYSIOGRAPHY.

THE ASSAM EARTHQUAKE OF JUNE, 1897.

A REPORT on the earthquake of June 12, 1897, in the Province of Assam has lately been published by the government of India in the form of a number of letters from local officers, English and native. The shocks occurred in the Khasi hills, famous as the district of the heaviest known rainfall; they are ascribed to faulting, entirely independent of volcanic action, of which there was no trace. Many ancient monolithic monuments were broken, or even torn out of the earth; their previously undisturbed condition being taken as evidence that no such earthquake had visited the region since their erection. In many villages the heavier houses were thrown down or badly injured, and had not most of the inhabitants been out of doors after a rainy morning the loss of life would have reached a greater number than is now reported, 1542. Among the hills much damage was done by landslides occasioned by the shocks; hillside paths were thus carried away, villages destroyed, and many people killed in the valley fields. In the plains to the south many deep cracks and crater-like pits were opened. One of the cracks was a mile long, two or three feet wide and 16 feet deep. Two persons lost their lives by being engulfed in such cracks. The pits average six feet in diameter and are spread around with sand that was thrown out by jets of water. In the Sylhet plains, traversed by numerous water courses, most of the villages are on the belt of higher floodplain close to the streams, and there much loss was caused by the slipping of the banks into the channels. Cholera and fever followed the earthquake, by reason of the disarrangement of water supply and drainage.

THE MOODUS NOISES.

A CORRESPONDENT of the New York *Sun* states that the "famous and mysterious disturbances of the lower Connecticut valley, the 'Moodus noises,' are being heard again" after a silence of twelve years. The Indians knew of them before the coming of white men. For twenty years, up to 1729, the villagers thereabouts heard the noises almost continuously, 'shaking the houses and all there is in them.' They were again heard in 1852 and 1885. On the recent recurrence there was a sound like a clap of thunder, followed for some two hours by a roar like the echoes of a distant cataract. A day later there was a crashing sound like heavy muffled thunder, and a roar not unlike the wind in a tempest. The ground was shaken, causing houses to

tremble and crockery to rattle, 'as though in an earthquake.' In view of the compressed condition of the rocks in the Monson quarries, described by Niles some years ago, these indications of local disturbance are of much interest and deserve special study from local observers. The region is one of deformed crystalline rocks, but all the disturbances that can be dated geologically are of great antiquity. The nearest comparatively modern disturbances are in the Cretaceous and Tertiary strata of the islands south of New England.

PHYSIOGRAPHY OF MARYLAND.

THE first volume issued by the Maryland Geological Survey contains a sketch of the physiography of the State with hypsometric and geological maps. A good illustration of the natural use of the term 'plateau' as indicative of relative and not absolute altitude is found in its application to the Piedmont region, next inward from the coastal plain. Its highest part in Parrs ridge is under a thousand feet elevation. Sugarloaf mountain seems to be a well defined monadnock, surmounting the plateau. The major drainage of this region is in young valleys that show little relation to the underlying rocks; their streams give evidence of having been superposed through a cover of sedimentary strata which may have been the westward extension of the present costal plain, but "the broad fertile limestone valleys to which the present drainage has become partially adjusted are a striking feature of the area." We venture to express a hope that the fuller study of physiographic features promised for later volumes will not be addressed so much to 'those who may seek a home in Maryland' as to the teachers in the schools of the State, from whom the future citizens are to learn what the State really is.

TARR'S FIRST BOOK OF PHYSICAL GEOGRAPHY.

TARR's Elementary Physical Geography has been found too advanced by many teachers; hence a smaller book has been prepared. In most respects it presents a good view of the subject, especially where the treatment turns toward the geological side; but in a number of instances it fails to 'start at the beginning and make everything thoroughly clear.' There is not a clear recognition of what is essential and what is unessential in a physical geography. The astronomical pages contain a number of purely astronomical matters, valuable as general information but here occupying space that could be better used by expanding the description and explanation of strictly geographical topics. The treatment of light is too physical and too advanced for a First Book. The chapter on the earth's crust is avowedly geological, so much so that the beginner cannot really appreciate it. For the student of geography it is better not to cross these geological bridges until they are encountered on his geographical journey. Under the lands many good lessons are taught, but process receives relatively more attention than form; and in spite of the importance which process deserves, this seems a mistake in a book that should be essentially geographical.

There are a number of careless inaccuracies of statement. It is said of hurricanes that "their birthplace is near the tropics" (p. 116). "The north magnetic pole lies to the southwest of the true North Pole" (p. 54). The redundant 'this' is too common; for example, 'in lieu of this inability to really conceive this' (p. 27). The treatment of the tides is not lucid; two sentences beginning with 'therefore' are followed by a third, whose conclusion will leave still in the dark those teachers who are puzzled about what they call 'that tide on the other side of the earth.' In these latter respects the book bears too evident marks of hasty preparation.

HARVARD UNIVERSITY. W. M. DAVIS.

CURRENT NOTES ON ANTHROPOLOGY.

THE PAPUANS AND MELANESIANS.

In a short article in *Globus* (Bd. 72, No. 9) Professor F. Müller sets in sharp contrast from the linguistic side the Papuans and Melanesians. The latter he considers to be Malayo-Polynesians, deeply tinged with Papuan blood, and speaking languages which are Malayan in grammar, but with a vocabulary containing a considerable residuum of Papuan roots. They have a decimal system, while the Papuans have only two numerals; the Melanesian dialects all have pronomial suffixes, which are wholly unknown in Papuan tongues; and other equally marked differences.

Like the negroes of Africa, the Papuans have a large number of widely distinct linguistic stocks; while it is well known that the Melanesians and Malayo-Polynesians are monoglottic. Physically the Melanesians are almost identical with the Papuans, but their tongues prove the deep influence of other blood. The purest examples of the Papuans are to be found in the interior of New Guinea, where they occupy a vast territory of which we know scarcely anything.

In this connection should be mentioned a paper on 'Observations on a Collection of Papuan Crania,' by Dr. George A. Dorsey, with notes on their decorative features by Professor Wm. H. Holmes, lately published by the Field Museum, Chicago. The measurements are most carefully done.

ETHNOGRAPHY AND HISTORIC SCIENCE IN AMERICA.

Under the above title Dr. F. Ratzel has an article in the *Deutsche Zeitschrift für Geschichtswissenschaft*, 1897, No. 3, appreciative of several recent works by American historical writers. He points out with force how the study of the aboriginal population of America has widened the range of historical views among us in the last quarter of a century. "Prescott described ancient Mexico as a curiosity which might have belonged to another planet. To-day the pre-Columbian culture of America pours light on the historic consciousness of Americans. Far beyond colonial history stretches the indefinite expanse of aboriginal history. This close relationship of history and ethnography forces the problems of the histories of races and peoples on the attention of every historical student."

Just how that relationship is to be understood and brought into the writing of history is a question which is not yet fully answered, as is easily evident from Dr. Ratzel's paper and the appendix to it by Dr. K. Lamprecht, one of the editors of the *Zeitschrift*. Enough, however, that it is recognized by such high authorities as one which can no longer be neglected.

D. G. Brinton.
University of Pennsylvania.

BOTANICAL NOTES.

ENUMERATION OF THE PLANTS OF EUROPE.

Seven years ago (1890) Dr. K. Richter brought out the first volume of a work entitled 'Plantæ Europææ,' which was intended to enumerate all the flowering plants growing spontaneously in Europe. The death of the author brought the undertaking to a standstill, and threatened to leave the work unfinished and fragmentary. Fortunately this calamity has been averted, and we are likely to see the work completed within a few years. Dr. M. Gürke, of the Berlin Botanical Museum, has recently issued the first fascicle of the second volume, and a second fascicle is promised within a few months.

The original plan of the work, which is practically unchanged by the new editor, included the systematic arrangement of all the European species under their proper orders and classes. The first description of

each species was to be carefully cited, and a full list of synonyms given. The original author adhered to the 'law of priority' with considerable rigidity, and therefore cited the dates of the accepted specific names and all synonyms. His initial date for the present system of nomenclature was that of the publication of the first edition of Linnæus's 'Species Plantarum,' viz.: 1753, and he discarded absolutely all earlier names. Dr. Gürke apparently does not so fully sanction the strict application of the law of priority, although he follows it in nearly all cases, his practice agreeing with that of the other Berlin botanists, who would except certain long-used names from the application of the law.

Volume I. included the Monocotyledons, which number 1839 species, 840 sub-species, and 122 hybrids. These are divided among 259 genera. The largest orders are the Gramineæ (751 species), Liliaceæ (342), Cyperaceæ (287), Orchidaceæ (170), and Iridaceæ (105).

The first fascicle of Volume II. includes a number of orders of apetalous plants, arranged in the Engler and Prantl sequence, viz.: Juglandaceæ (1 species), Myricaceæ (2), Salicaceæ (234), Betulaceæ (24), Fagaceæ (34), Ulmaceæ (7), Moraceæ (22), Loranthaceæ (4), Santalaceæ (26), Balanophoraceæ (1), Aristolochiaceæ (16), Rafflesiaceæ (1), Polygonaceæ (138), and Chenopodiaceæ (unfinished, 89). In many of the foregoing orders the numbers include many hybrids. This is especially true of the Willows, of which there are 48 distinct species and more than three times as many hybrids (178); of the Oaks there are 21 species and 11 hybrids, but here there are included under the 21 species no less than 52 sub-species.

THE DISEASES OF BERMUDA LILIES.

THE beautiful lilies which are annually grown in enormous quantities, to be used for decorative purposes during the Easter services, have become seriously affected by some obscure diseases which threaten to drive out their cultivation. For some time Mr. A. F. Woods, the Assistant Chief of the Division of Vegetable Physiology and Pathology, in Washington, has been studying these diseases, in the hope of finding their cause and cure. The diseased condition is characterized by the spotting and distortion of the leaves, flowers and bulb-scales, and the stunting of the plants. In severe cases the leaves, as they appear above the ground, are marked with small, yellowish-white shrunken spots, which finally dry out and collapse. Occasionally the disease appears to be somewhat local, the leaves on one side of the stem, or of particular whorls, alone being affected. It is estimated that from twenty to sixty per cent. of the entire hot-house crop of these lilies is annually destroyed by disease.

Many theories have been suggested as to the cause of the trouble, some attributing it to the growth of the bulbs upon worn-out soils, some to the weakening of the vitality of the plants by unscientific treatment, as premature removal of leaves, premature harvesting of the bulbs and want of care in the selection of bulbs for propagation. Others again suggest that bad treatment of the bulbs in the forcing house is the principal cause, while still others think that insects produce the trouble.

Mr. Woods finds, upon investigation, that, instead of one disease, we have to deal with several. The lilies are suffering from a complication of diseases. He summarizes his results as follows: "The work done shows that the disease is due to a combination of causes. In the first place, the bulbs have become weakened through improper selection and improper propagation, and this weakening is further increased by the attacks of mites and certain fungi and bacteria. Bulbs which have

been weakened in this way might regain their strength if the mites and fungi could be kept down; but those which are naturally weak cannot be made strong. During the time plants are being forced they may also be weakened by overwatering and consequent asphyxiation of the roots, or by allowing the roots to become too dry and then overwatering. The foliage of such plants may be free from spots and distortions, but usually the leaves are badly diseased. The spotting and distortion of the foliage is often due to the direct attacks of several genera and species of aphides and of the young of the bulb mite; to the injection of water into the young leaves in watering or syringing, and to the presence of water between the young leaves of plants having soft foliage. The injuries from the attacks of organisms are always more severe in the susceptible or naturally weakened bulbs."

No single course of treatment can be recommended to help this trouble. Careful selection of the bulbs, rotation of crops, avoidance of premature cutting of the stems or digging of the bulbs, the use of aërated soil, care in watering, the careful destruction of aphides and mites and the use of chemical fertilizers, instead of those derived from animal excrement, are recommended as likely to materially check the disease.

Charles E. Bessey.
University of Nebraska.

NOTES ON INORGANIC CHEMISTRY.

A recent number of the *Zeitschrift für anorganische Chemie* contains a review of the recent work on the genesis of petroleum and other natural hydrocarbons. Engler's hypothesis is that petroleum is formed by the distillation of animal fats at high pressure. Lobry de Bruyn has described a demonstration of this method of formation as a simple laboratory experiment. Heusler calls attention to the fact that Engler's distillate contains a considerable quantity of unsaturated hydrocarbons, which is not the case with petroleum. By treatment with aluminum chlorid these hydrocarbons are changed into a high-boiling lubricating oil; hence it is probable that petroleum formation took place in two stages, the first distillate being changed by metallic chlorids into petroleum. According to Ochsenius, petroleum was formed from plant and animal remains by heat and pressure under the influence of the salts derived from sea water. On the other hand, Moissan finds in his work on the metallic carbids, a confirmation of the theory first proposed by Mendeleef, that petroleum originates from the action of water on metallic carbids in the interior of the earth. Uranium carbid, for example, yields with water both solid and liquid hydrocarbons. These are, indeed, in part unsaturated, but at a higher temperature saturated hydrocarbons might be formed from them by the action of hydrogen, which is often evolved from carbids by water. Aluminum carbid and glucinum carbid, indeed, give with water pure methane (marsh gas). Viola believes that the asphalt and the petroleum of Castro de Volci, near Rome, in Eocene limestone and sandstone is of intratelluric origin, and has been distilled from great depths. The region shows decided evidence of volcanic phenomena. On the other hand, van Werweke holds that the petroleum of Pechelbronn, in Lower Alsace, has originated in Tertiary strata and has not come from below.

In a polemic article in the *Zeitschrift für angewandte Chemie*, D. Holde claims that the theory that petroleum has originated from animal remains should be known as the Engler-Höfer theory, Höfer having first proposed the theory in 1888 in his 'Das Erdöl und seine Verwandte,' and Engler having

by his experiments shown that petroleum can be thus formed.

FINALLY, Moissan, in the *Comptes Rendus*, states it as his opinion that according to its geological relations the formation of petroleum is to be ascribed to three different causes: (1) the decomposition of organic substances under the influence of pressure and heat; (2) the purely inorganic reaction between water and the metallic carbids; (3) volcanic processes. In many localities it is possible that all three of these factors may have contributed to the formation of petroleum.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

IN accordance with plans that we have already announced, the General Committee of the British Association for the Advancement of Science has decided that the next meeting will be at Bristol, under the presidency of Sir William Crookes.

SIR JOHN LUBBOCK has accepted the presidency of the International Congress of Zoology, which meets at Cambridge in August of next year. Sir William Flower was, as we regret to learn, compelled to resign the office, in view of the other pressing demands on his time and of medical advice.

PROFESSOR C. A. YOUNG, Professor A. A. Michelson and Professor E. S. Dana have been elected honorary members of the Philosophical Society of Cambridge University.

THE medals of the Royal Society will this year be awarded as follows: The Copley Medal to Professor Albert von Kölliker; a Royal Medal to Professor A. R. Forsyth; a Royal Medal to Sir Richard Strachey; the Davy Medal to J. H. Gladstone; and the Buchanan Medal to Sir John Simon.

SIR ROBERT BALL, President of the Royal Astronomical Society, has been presented with the Jubilee Medal.

DR. GEORGE H. HORN, the eminent entomologist, died at Philadelphia on November 25th. He was one of the Secretaries of the Philosophical Society and was formerly Corresponding Secretary of the Academy of Natural Sciences. He had been until recently professor in the University of Pennsylvania, though his connection with that institution was chiefly honorary. Dr. Horn was only fifty-eight years of age, and his death, following those of Cope and Allen, is a further severe loss to the city of Philadelphia and to science in America.

THE Rev. Dr. Samuel Houghton, from 1851 to 1881 professor of geology in Trinity College, Dublin, died on October 31st, aged seventy-six years. He was an original and versatile writer, having made many contributions not only to zoology and physiography, but also on medical subjects, including an elaborate work on the Principles of Animal Mechanics.

BY a private letter from Dr. J. Buttikofer we are informed that, although by the necessities of his recent appointment as Director of the Rotterdam Zoological Garden he has been obliged to leave Leyden Museum, where he has spent so many happy years, and which contains nearly all the zoological collections made by him in different countries of the world, he hopes, that as Leyden is distant but three-quarters of an hour from Rotterdam, to be able to do some ornithological work there. He is now engaged in finishing his report on the ornithological results of the Borneo Expedition, which he accompanied as zoologist, and of which some account was printed in SCIENCE of April 23, 1897.

PROFESSOR R. A. PHILIPPI, who, for forty-three years, has been Director of the National Museum in Santiago, Chile, having reached the age of ninety years, has resigned, and is succeeded by his son.

A MONUMENT to the eminent surgeon, the late Professor Billroth, was unveiled in Vienna on November 7th. Professor Gussenbaur, formerly assistant to Professor Billroth, made the principal address.

A BUST of Michael Faraday was unveiled at the Michael Faraday Board School, London, on November 15th. The bust, which is of white marble, was presented to the School by the managers of the Royal Institution of Great Britain, and is a copy of the original bust exe-

cuted by Matthew Noble. A brass tablet on the adjacent wall bears the following inscription: "Michael Faraday, natural philosopher, D.C.L., F.R.S., born at Newington, Surrey, September 22, 1791. He was a patient student, an eloquent expounder and a brilliant illustrator of the laws of nature. Fullerian Professor of Chemistry in the Royal Institution of Great Britain, 1833 to 1867. Faraday's noblest monument is his 'Experimental Researches in Electricity and Magnetism' from 1831 to 1851. He died at Hampton Court-green, August 25, 1867, and was interred in Highgate Cemetery."

LIEUTENANT PEARY sailed on the Lucania on November 27th and will lecture in Edinburgh, after which he will try to find in Scotland a vessel of from 300 to 500 tons register for his next expedition to the north.

THE steamship carrying the Belgian Antarctic Expedition has safely reached Rio Janeiro and left for Buenos Ayres on October 28th.

MM. RAOUL and Mary have returned to Paris from a governmental mission to make researches into the indigenous plants of the Malay peninsula, with a view to determine whether any of them are of use for pharmaceutical or commercial purposes.

PROFESSOR JADERIN, of Stockholm, has, according to the New York *Evening Post*, proposed to the Academy of Science of that city that it arrange with the government for a preliminary expedition, with Russia's cooperation, to go to Spitzbergen next summer, and there prepare for the final measurement of a degree of latitude in 1899 and 1900, with a view of obtaining more exact knowledge of the earth's form.

LIEUTENANT OLUFSEN, who returned last spring from Central Asia, will next year fit out a new expedition to the Pamir regions in order to make geographical and ethnographical explorations in the northern part of the Wakhan valley. The expenses of the expedition, which will last two years and include two scientific students, will be paid from the Carlsberg fund of the Danish government.

THE New York Park Board approved, on November 22d, the general plans of the zoological gardens in Bronx Park. There was no opposition to the plans at the public hearing.

THE Meteorological Institute of Berlin celebrated the fiftieth anniversary of its foundation on October 14th. Dr. von Bezold, Director, made an address, in which, according to *Die Natur*, he stated that the Institute had in North Germany 188 stations of the first class and nearly 2,000 smaller stations.

A SMALL marine laboratory, says *Nature*, was opened at Cullercoats on the 21st ult. by Principal Gurney, of the Durham College of Science, Newcastle-on-Tyne. The laboratory is the result of the public-spirited generosity of John Dent, Esq., the Vice-Chairman of the Committee. The laboratory was formally handed over to the Sea Fisheries Committee, to be worked in conjunction with the Durham College of Science, Mr. Meek being placed in charge of the scientific operations. A large company assembled, representing the Sea Fisheries Committee, the College of Science, the Natural History Society and the County Council.

THE Subtropical Laboratory of the United States Department of Agriculture, at Eustis, has been discontinued, but work will be done at Miami, Florida. Mr. Walter T. Swingle and Mr. H. J. Webber, who had charge of the laboratory at Eustis, are at present in Washington.

THE Smithsonian Institution has acquired the Hallett Phillips collection of Indian implements and antiquities from the Potomac valley.

MR. P. A. B. WIDENER, of Philadelphia, has given his residence on Broad street for a branch of the Free Library. The value of his gift is said to be one million dollars.

THE Annual Report of the British Board of Agriculture states that during the financial year 1896–7 the sum of £6,950 had been distributed to fourteen different educational institutions. The grant to the Durham College of Science was increased to £1,000, and that to Oxford University to £800. The Board recommends that a chair of agriculture and forestry be established at Cambridge University.

As the result of the preliminary examination made by Colonel Sir Thomas Holdich, the well-

known head of the Indian Survey Department, whose services were lent to the Ceylon government last winter by the government of India, a new survey is to be made of the island. The London *Times* states that the cadastral survey will be on a scale of 10 in. to the mile and the topographical on one of one in. to the mile. The triangulation and topographical survey will be completed in five or six years, but considerations of expense will cause the cadastral survey to be spread over a period of 25 years and to be restricted to crown lands and lands of doubtful ownership. The existing maps of Ceylon are full of errors, and for every grant made out of crown lands a special and expensive cadastral survey of the locality had to be executed.

THE Pirogof Museum of Surgery and Anatomy, in St. Petersburg, the plans for which we have already noted, was opened at the beginning of the present month. The building will serve not only as a museum, but also as the place of meeting of all the St. Petersburg medical societies. The $30,000 bequeathed for the purpose by Mme. Musin-Pushkin has been doubled by subscriptions, and some endowment remains after the cost of the building has been defrayed.

THE International Congress on the Protection of Birds, to which we have already called attention, opened at Aix-en-Provence on November 9th. The London *Times* states that the protection of insectivorous birds useful to agriculture was the chief matter discussed, and it was decided to forward to the governments of Europe, through the French Minister of Foreign Affairs, the resolutions that were formulated. Public educational bodies are also to be approached in order to obtain, if possible, the serious consideration of this important subject by schoolmasters and government school inspectors. Numerous French and Italian agricultural, horticultural and sporting societies were represented at the Congress, and delegates from the Selborne Society and the Society for the Protection of Birds were also present.

THE Civil Service Commission announces that on January 8, 1898, an examination will be held at Washington, D. C., and other places throughout the United States, for the position of Computer in the Nautical Almanac Office. Three vacancies are to be filled and only men are eligible.

THE University of Cambridge has after a long delay received $5,000 bequeathed by the late Dr. Joseph Gedge, who died in 1870 while with Sir Samuel Baker at Khartoum. The fund is for the establishment of a biennial prize for original research in physiology. It is open only to graduates of the University of more than five and less than seven years' standing.

DR. HUGHLINGS-JACKSON will give, on December 8th, the first lecture under the Jacksonian lectureship, established by the Neurological Society of London in his honor.

PROFESSOR OLIVER LODGE will deliver a course of six Christmas lectures (specially adapted to young people) on 'The Principles of the Electric Telegraph' at the Royal Institution, beginning on December 28th.

PROFESSOR ROYCE, of Harvard University, will deliver, at Cambridge, during the present year, six public lectures on 'Social Psychology.'

AT the meeting of the Botanical Club of the University of Chicago on November 23d Professor C. F. Millspaugh, Curator in Botany at the Field Columbian Museum, gave an account of his explorations in Yucatan, made on behalf of the Museum.

DR. H. C. PARKER gave, on November 29th, the first lecture in the course given annually by the New York Academy of Sciences. His subject was 'Recent Explorations in the Rocky Mountains of Canada,' including an account of the first ascent of Mount Lefroy, made by him last summer.

THE first of the Columbia University lectures in cooperation with the American Museum of Natural History will be given by Professor Kemp on Saturday, December 4th, and the two following Saturdays. The subject of his course is 'The Formation and Structures of the Crystalline Rocks.'

PROFESSOR GEORGE H. DARWIN, of Cambridge University, will lecture at Columbia University on the afternoon of December 10th,

nis subject being 'The History of the Earth and of the Moon.'

AT the last meeting of the Zoological Society of London it was reported that the additions to the Society's menagerie during the months of August, September and October were 435 in number, amongst which special attention was called to a male and two females of a large deer from the Altai Mountains, probably referable to *Cervus eustephanus*, and apparently different in species from any deer previously exhibited in the Society's gardens, and also to a young male of the Caucasian wild goat (*Capra caucasica*). The total number of visitors to the Society's gardens during the months of August, September and October was stated to have been 278,253, representing an increase of 55,283, as compared with the number for the same period in 1896. From this source alone an increase of £1,344 19s. had been received during the same period.

MR. L. O. HOWARD, of the Department of Agriculture, has been studying the work of the Massachusetts Gypsy Moth Commission in the neighborhood of Malden and Medford, with a view to the preparation of a special bulletin of the Division of Entomology, describing the process of extermination employed. Agent O. A. Hubbard, of the Committee, has been temporarily detached and detailed by the State Board of Agriculture to study the region infested by the brown-tail moth and warn property holders of the danger and the need of using active measures for its destruction.

MR. H. A. MORGAN gives, in Bulletin No. 48 of the Louisiana Agricultural Experiment Station, some interesting observations on *Trissolcus murgantiæ*, an important parasite in the eggs of the harlequin cabbage-bug in Louisiana. He finds that eggs of the cabbage-bug pierced by the parasite on July 20th produced adult parasites on July 30th, showing the entire life cycle of the parasite to be ten days. In August 60% of the eggs of the harlequin bug contained these parasites. Experiments are being conducted with a view to the introduction of this parasite into Kentucky and Ohio.

SINCE the *Medical News* was removed to New York, giving that city three of the four leading medical weeklies of America, the scientific and medical men of Philadelphia have felt the need of a good weekly journal. This will be filled after the first of January by the publication of the *Philadelphia Medical Journal*, to be edited by Dr. George M. Gould, and published by the Philadelphia Publishing Company, with a capital of $30,000, which we understand has been fully subscribed. The trustees consist of the leading physicians and medical professors of Philadelphia, the different schools being duly represented.

L'Intermediare des biologistes, the plans for which we announced sometime since, has now begun publication, the first number being dated November 5th. It will be published twice a month, and the present number contains twenty-four pages. In addition to an introduction we find a short article by M. Marey, advocating the plan brought forward by him at the recent meeting of the French Association in favor of an international control of physiological instruments; forty-six questions to which replies are requested; the contents of the special journals of zoology, botany, physiology and psychology and short descriptions of three instruments. The journal throughout shows the psychological interests of Professor Binet and his associates in the editorship. In the introduction it is stated that a complete bibliography of the literature, so far as it is contained in other journals, will be given, but we think that the magnitude of this undertaking is scarcely realized. The series of questions is a feature that has, perhaps, not been undertaken in a scientific journal and may prove of value. Among the 34 'collaborateurs' there are two Americans, Professors Minot and Baldwin, and one Englishman, Dr. Sherrington. The price of subscription for America is 12 fr., to be sent to the publishers, Schleicher Fréres, Paris.

THE last issue of *Industries and Iron* states that it is the first newspaper produced in Europe by the aid of the Lanston Monotype type-casting and composing machine. The whole of the matter in the body of the paper has been printed from types composed and justified into lines on the keyboard machine,

and the jacquard or perforated paper so produced has enabled the casting and setting into lines and galleys of the finished matter presented.

THE new rules of the United States Patent Office, which go into effect on January 1st, contain some important alterations. Hereafter no invention can be patented if it has been described two years or more before the filing of the application, or more than seven months after a foreign patent has been allowed. On the other hand, the duration of an American patent is not limited by its expiration in other countries.

THE South African Republic has passed an amendment to their patent laws which is an ingenious method of collecting revenue. Only a small fee is required for granting the patent, but for each period for which it is extended an additional payment is required. Thus, for example, from eleven years to the limit of fourteen years $1,000 is required.

A DEPUTATION from the Manchester Chamber of Commerce was received by the President of the British Board of Trade on November 17th, the object of which was to call attention to the fact that patent rights were granted to foreign subjects in Great Britain for inventions which cannot be patented in their own. It was stated that very serious injury was inflicted upon British industrial interests in consequence of this inequality, and it was asked that the Patents Act of 1883 should be amended so as to remove the inequality, and that the duration of any British patent granted to a foreigner should not exceed the term of his patent in his own country. The deputation also desired that, as complementary to this amendment, the British representative at the forthcoming congress of the international convention for the protection of industrial property, to be held in Brussels next month, should be instructed to support the propositions for the alteration of the rules of the convention, which would permit the amending legislation in question.

MR. CHARLES T. RITCHIE, President of the British Board of Trade, in a speech before the Croydon Chamber of Commerce on November 23d, is reported to have said that Great Britain had more to fear from the United States than from Germany in industrial competition. "The facts are serious," he continued, "and call upon us for the exercise of all our powers to enable us to maintain our position in the commercial world. There is no doubt the United States are executing orders which ought to be executed here. As we all know, an American firm obtained the contract for the Central Underground Railway (of London), as its bid was lower than those of the English concerns and it could deliver the supplies three months ahead of the British tenders. Many important Continental orders have gone to America. The same is to be said of Egypt and Japan, where the Americans are doing work that Englishmen should have done."

THE conductors of the London *Academy* have devised a successful plan of advertisement in selecting a British Academy of Letters and its forty 'Immortals.' With the exception of two or three superannuated giants and half-a-dozen contemporary men of letters, the list seems to be chiefly remarkable as an exhibition of the mediocrity of British literature. The only excuse for mentioning the proposed Academy in this place, however, is to call attention to the fact that it does not contain the name of a single man of science. It is probably true that there is now in Great Britain no man of science who is also a man of letters as Huxley was; still if philologists such as Professor Skeat and Professor Jebb, and historians such as Bishop Stubbs and the Rev. Dr. Gasquet, are included among the forty Olympians there seems to be no reason why men of science such as Lord Kelvin, Professor Foster, Professor Sidgwick and Mr. Galton should be excluded.

THE fiftieth anniversary of Professor Virchow's joining the teaching staff of Berlin University was celebrated on November 6th. The *Lancet* states that in 1847 Professor Virchow, who had previously belonged to the Army Medical Staff, was appointed a *privat-docent* at the University, but political considerations were all-powerful after the revolutionary troubles of 1848, and as he was known to hold democratic opinions he was under the necessity of leaving Berlin and accepting a professorship

at Würzburg, in Bavaria. His exile, however, did not last very long, for as far back as 1856 he was elected professor of pathological anatomy in Berlin, an appointment which he still retains. On account of Professor Virchow's infirm state of health the jubilee proceedings were of a more private character than would have otherwise been the case, being limited to addresses of congratulation delivered by the rector of the University and the dean and professor of the medical faculty. The rector, Professor Schmoller, referred to Professor Virchow's achievements not only as a physician and a pathologist, but also as a biologist and as a savant whose methods of research had influenced every branch of human knowledge. The dean, Professor Huebner, eulogized him as a *privat-docent* of an altogether superior order—a teacher not only of students, but also of professors. At an age when young men were, as a rule, far from having mastered what had been already discovered he succeeded in solving the most difficult problems of biology. Professor Virchow in his reply pointed out that he was happy in the knowledge that a body of men now existed in German universities strong enough not only to maintain the principles laid down by him, but also to continue the work in the light of modern developments. He felt that his work was done and that he was now entitled to retire from his academical position, especially after having succeeded in obtaining a promise from the government that a new and modern pathological institute and museum would be constructed after his designs. A great number of telegrams, letters and other marks of Professor Virchow's great popularity were received by him during the day.

THE National Photographic Record Association of Great Britain, to which we have already called attention, have sent out a circular in which they state that well-wishers of the Association, the subscription fee for which has been fixed at a small sum with the object of enlisting wide and general support. Photographers and others can assist by contributing photographs (which must comply with the regulations set forth in the by-laws), or by acting as honorary agents and collectors in their respective localities. The Council look for generous support from photographic and camera clubs throughout the country, as well as from individual amateur photographers, who must now form a complete network of workers over the whole British Islands. The Council also appeal to the large and important professional class of photographers for copies of rare and especially interesting pictures taken by them. From scientists, antiquarians and others assistance is desired in searching among the rich stores of old and neglected negatives taken in past years which are known to exist, the identification of which gets more difficult as time passes, and also by using influence with their amateur photographic friends in inducing them to seize opportunities of recording passing events. Others may render valuable help by purchasing pictures from dealers and presenting them to the national collection, thus rescuing records which might otherwise be lost. In the course of the present jubilee year there must have been many thousands of photographs taken of local celebrations, which, if brought together, would form a most valuable chapter of national history, and it may be remarked in passing that it should be born in mind that a single picture of historical interest will always be acceptable. In conclusion, the Council wish it to be understood that there is no thought of competing or clashing with the excellent work of the same kind which is being so well done by the several county photographic survey associations, such as those of Warwickshire, Worcestershire, Yorkshire, Cheshire, etc., in their commendable efforts to form local collections, but rather a hope is entertained that such useful work may be encouraged by loans being made from time to time from the national collection, before being deposited in the British Museum, of interesting pictures from other localities for the purposes of exhibition.

The Botanical Gazette states that the Seaboard Air Line Railroad, which extends from Portsmouth, Va., to Atlanta, Ga., has inaugurated a novel system of instruction of the communities along its territory. During the present season it has been holding one-day farmers' institutes, all illustrative material and appliances and the force of instructors being transported from place to place in a train of cars especially fitted up

for the work. It is proposed to establish experimental farms every ten miles along the whole line, twenty-eight having already been organized.

AT the first meeting of the present season of the Royal Geographical Society, the President, Sir Clements Markham, made an address in which he says, according to the report in the London *Times*, that the recess had been signalized by the publication of two important geographical works—the admirable monograph on British Central Africa, by Sir Harry Johnston, with its fascinating chapters on the scenery and the physical aspects of that region; and the 'First Crossing of Spitzbergen,' by Sir Martin Conway; while they had themselves brought out Sir William Macgregor's interesting paper on 'British New Guinea' in the form of a small volume. There had also been much activity in the field. In Africa, Mr. Cavendish, who only completed his twenty-first year last May, had made a very remarkable journey from Berbera, across the Somali country, to the river Jub, and then inland to Lake Rudolf. He shared with the late Captain Bòttego the honor of being the first to explore the western shores of that lake. With regard to Siam they might expect another communication from Mr. H. Warington Smyth. In Central Asia the labors of Dr. Sven Hedin, which had been continuous during several years, were of great geographical importance. Not less important and quite as interesting were the explorations now being carried on in the Afridi country by their gallant associate, Sir William Lockhart. They must all feel enthusiastic on reading of the skill and ability with which his old friend was conducting a most difficult campaign, and of the brilliant dash and devotion of the Gordon Highlanders and other troops who were serving under him. As Fellows of that Society they rejoiced that the success of their arms also entailed successes for the cause of geography. Their friend and associate, Mr. Fitzgerald, was also returning from his arduous examination of Aconcagua, which was believed to be the loftiest peak in the Chilian Andes. There would, so far as he was aware, be no new work from the Antarctic regions during the ensuing season, unless, as he hoped, the Belgian expedition, commanded by M. de Gerlache, should be able to send news of any discovery before the close of the season. But the efforts of their Council to procure the dispatch of a British Antarctic expedition had never ceased. Meanwhile, Sir George Newnes had supplied funds for a Norwegian enterprise, to be conducted by Herr Borchgrevink. In the Arctic regions there had been much activity this summer, and it was reported that it was the most open season that had been known for many years. They now had to welcome Mr. Jackson, Mr. Armitage, and the other members of the expedition on their safe return, and to congratulate Mr. Harmsworth on the valuable results of his patriotic munificence. Following the President's address, Mr. Frederick G. Jackson lectured on the scientific results of the Jackson-Harmsworth expedition.

AT the opening meeting of the Linnæan Society, London, an interesting collection of zoological and botanical exhibits collected by the Jackson-Harmsworth expedition was shown by Mr. F. G. Jackson, the leader, and Mr. Fisher, the botanist of the expedition, the former also exhibiting upon a screen a number of photographs of animals and birds which inhabit the Arctic regions. Some lantern slides of marsh birds and their nests from photographs recently taken in Spain and Holland were shown by Mr. Reginald Lodge. Following a discussion upon these exhibits, Sir John Lubbock, M. P., read a paper on 'The Attraction of Flowers for Insects,' in reply to three memoirs recently published by Professor Plateau. According to the report in the London *Times* Sir John Lubbock explained that his view was, like that of Sprengel and Darwin, that we owe to insects the beauty of our gardens and the sweetness of our fields. To them, he said, flowers were entitled for their scent and color. Not only had the present shapes and outlines, brilliant colors, the sweet scent and the honey of flowers been gradually developed through the unconscious selection exercised by insects, but this applied even to minor points, such as the arrangement of lines and the different shades of color.

UNIVERSITY AND EDUCATIONAL NEWS.

MR. THOMAS MCKEAN, of Philadelphia, has given $100,000 to the University of Pennsylvania for a building for the law school.

MR. JOHN D. ROCKFELLER, of New York, has given an additional $10,000 towards the erection of a hall at Mt. Holyoke College, and if the conditional gift of Dr. Pearson is included the sum of $175,000 has now been collected for the endowment fund.

BROWN UNIVERSITY has received $5,000 by the will of the late Eustace Fitz, of Chelsea, Mass.

FERRY HALL, one of the buildings of the State Agricultural College, Pullman, Washington, has been destroyed by fire, causing a loss of about $40,000.

THE registration in Harvard College is this year 1,814, an increase of 6.2 per cent. over last year. The number of students in the Lawrence Scientific School is 407, an increase of 9.5 per cent.

IT is stated that the decree excluding foreign students from the medical classes of the Faculty of Medicine of Paris will shortly be withdrawn.

DR. TH. CURTIUS, professor of chemistry at Bonn, has been called to Heidelberg as successor to Victor Meyer.

DISCUSSION AND CORRESPONDENCE.

HOTEL ACCOMMODATIONS AT ITHACA FOR MEMBERS OF THE SCIENTIFIC SOCIETIES.

SINCE the publication of the official announcement of the Society the Ithaca Hotel has been sold, and the new owners have closed it for extensive repairs. That hotel will not be open for guests nor for the annual dinner. The other hotels will be open. The Clinton House can accommodate from 50 to 75 and the new Hollister from 30 to 40 guests.

The annual dinner announced for the Ithaca Hotel will be held at the dining rooms in Cascadilla Place, these being the largest and pleasantest dining rooms upon the University campus in Ithaca. The time and cost will be as in the announcement.

A limited number of ladies can secure rooms and board at Sage College. Rates can be had upon application to the Local Secretary. There are numerous pleasant rooms in the near neighborhood of Cascadilla Place, which, with board in the house or at Cascadilla Place, would cost from 75 cts. to $1.50 per day. The Local Secretary will secure rooms for any who apply to him.

S. H. GAGE, *Chairman*,
W. W. ROWLEE, *Secretary*,
of the Local Committee.

ITHACA, N. Y.,
November 30, 1897.

THE CAIRN ON THE ENCHANTED MESA.

TO THE EDITOR OF SCIENCE: I have just read Professor Libbey's letter, in your issue of the 26th instant, in which he intimates that the lichen-covered cairn on the summit of the Enchanted Mesa was erected by himself. It now only remains for Professor Libbey to say that the ancient potsherds scattered through the talus, the artifacts found on the summit, the remains of the ancient ladder-trail and all the other evidences of the former occupancy of the summit of the mesa are the result of his own ingenuity. The last word will then have been said.

F. W. HODGE.

BUREAU OF AMERICAN ETHNOLOGY,
WASHINGTON, November 29, 1897.

[As Professor Libbey states that the cairn was erected by him Mr. Hodge should certainly correct his mistake. Whether or not the Mesa was formerly inhabited is another question.
ED. SCIENCE.

A POSSIBLE SOLUTION OF THE SEALING PROBLEM.

TO THE EDITOR OF SCIENCE: In the article in SCIENCE last week on the Sealing Conference, and in the innumerable articles that have been published since the question became prominent, I have not noticed any mention of what seems to an outsider the most natural solution. It is absurd for the United States to claim that it has any right to control the action of Canada on the high seas on the ground of humanity to animals or of commercial interests. Great

Britain would have just as much right to protest against the extermination, by the United States, of the buffalo and the beaver.

It has been suggested that the seals might be exterminated, but this would be sawing off the branch with the man on it, unless the proposers of this plan mean by it what I wish to suggest. This is that so many seals be killed on the Islands that there would not be enough left in the seas to make pelagic sealing profitable. It would seem possible to keep a small herd on the Islands and the killing of the small number would be very profitable, as the price of sealskins would doubtless rise. It looks to me as if we had the trump card in our hands and could offer Great Britain almost any conditions on pelagic sealing that we like.

P. C. H.

NEW YORK, November 27, 1897.

OBSERVATIONS ON THE PHYSIOGRAPHY OF WESTERN MASSACHUSETTS.

THE following notes on the character and elevation of the Cretaceous peneplain in western Massachussetts were made during a trip in the Berkshire region in the spring of 1897. The area covered lies between the Housatonic and Connecticut lowlands and south of the Boston and Albany Railroad.

From map-study alone the tendency is to locate the peneplain by the broadest tracts of level country to be found upon the map and to call what lies above monadnocks. It was found, however, that this estimate placed the peneplain altogether too low. The broad spaces proved on observation to be broad, shallow tracts of etched-out country, and most of what had been supposed from map-study to be monadnocks fell into a very good level skyline. The region contains but few monadnocks, and these of small size, their size and number decreasing from north to south.

In the township of Hinsdale the peneplain lies at a height of 2,050 to 2,100 feet; at Washington Centre it falls to 2,000 feet; and seven miles in a south-southeasterly direction, near Becket Centre, it is but 1,850 feet in height. Between Sandisfield Centre and New Marlborough, about seventeen miles due south of Washington, the height of the peneplain decreases to 1,750 feet; at Tolland Centre its elevation is about 1,550 feet; and at Blandford Centre, about eight miles to the northeast, the same. By comparison of these points the following conclusions were reached:

(1) The peneplain dips from about north-northwest to south-southeast.

(2) Its fall in twenty-five miles is about 550 feet, a rate of twenty-two feet to the mile.

An apparent consequence of this slope of the peneplain is the prevailingly south-southeast courses of the streams, great and small, throughout the area. Along the escarpments where the upland falls off into the Housatonic lowland or into the Connecticut lowland the streams naturally follow the steeper gradient and have cut east and west courses some distance back into the upland, though even these streams in their upper courses conform more and more to the habit of the other streams. The long axes of the lakes and ponds also lie prevailingly northwest and southeast, and the majority of the long, straight stretches of road follow the same direction.

ROLAND B. DIXON,
CHARLES D. DREW.

SCIENTIFIC LITERATURE.

The Dawn of Astronomy, a study of the temple-worship and mythology of the ancient Egyptians. By J. NORMAN LOCKYER. New York and London, The Macmillan Co. First edition, 1894; second edition, 1897. Octavo, pp. 432. Illustrated. Price, $3.

Sir Norman Lockyer first gave his attention to the questions treated in this book in the year 1890 and they are stated in his preface somewhat as follows: It is a matter of common knowledge that many of the churches of England are so constructed that their eastern windows face the point of sunrise on the day of the patron saint. For example, the churches dedicated to St. John the Baptist face nearly northeast. The question arises whether the Egyptian temples have a similar orientation to the sun or to some star. This can be completely determined by accurate surveys of the temple sites; by an investigation of the inscriptions, etc.; by a study of the mythology and history of the people; by the calcu-

lation of tables of the rising and setting of the stars for a period extending backward some 9,000 years, and by a painstaking discussion of the data so amassed. A part of the work described has been done by Professor Lockyer, and the results reached since the year 1890 (when some of them were first announced by him) are set forth in this volume. During visits to Egypt he executed surveys of a few temple-sites and the necessary calculations have since been made.

The French Scientific Commission which accompanied Napoleon in his Egyptian campaign, and the Commission sent by the Prussian government in 1844, have published a vast amount of accurate information regarding the sites, etc., of Egyptian monuments which bears directly on the problem in hand.

Professor Lockyer's general conclusion is that certain of the Egyptian temples are, in fact, oriented by the stars as well as others by the sun. The same conclusion was reached quite independently in 1885 by Professor Nissen, of Germany, though his work was unknown to Lockyer at the time. Such is the general problem. The particular developments are given in a stout octavo volume first printed in 1893 and now reprinted without change, I believe.

The course of the argument in detail is somewhat as follows: Egyptian chronology, the succession of kings, must be regarded as comparatively well known, considering the great difficulties of the subject. Making all allowances for errors, the dates of many temples are well fixed by their inscriptions. The mythology of Egypt has likewise been studied with remarkable success, and this mythology has, in general, astronomical relations, as indeed is the case in many countries. In Egypt, as in other lands, there were gods related to the sun, the moon, and a special goddess for the stars. Their zodiac is represented by existing sculptures whose figures have at once a mythologic and an astronomic meaning. The priests made sacrifices at dawn and at other seasons related to the sun's diurnal and annual courses. Inscriptions at Thebes show that the risings of stars were observed throughout the entire year; and the *heliacal* rising of Sirius was connected with the floods of the Nile. In Egypt, as in India, the pantheon was mainly composed of solar deities, but some of the personages had intimate relations to stars and planets.

During the course of the year the sun rises and sets at various points of the horizon of any place. It rises farther to the north during the summer, farther to the south during the winter season. A star, however, rises at (sensibly) the same point of the horizon for a century or so, though the stars, too, have a slow motion due to precession, which will, finally, produce great alterations in their points of rising. The rising of a star with the sun at a certain period of the year—its *heliacal* rising—would be a marked phenomenon, especially if the date coincided with a critical time of the agricultural cycle. Any recurring event of this nature may serve to mark off dates—the heliacal rising of a star; the rising (or setting) of the sun at the equinoxes or solstices; or the rising or setting of a fixed star. The orientation of a temple might well preserve the direction in which the semi-sacred appearance was visible and there is no doubt that many structures have been so oriented. From ancient times worshippers have chosen to face in a fixed direction during their devotion or sacrifice.

The existence of solar temples in many parts of the world is established beyond a doubt. Some Egyptian temples are oriented to the sun at its rising at the solstices (Karnak, Thebes, etc.); some to its rising at the equinoxes (Memphis, Gizeh, etc.) according to Professor Lockyer. The orientation is changed from solstitial to equinoctial in these cases, and Lockyer points out that so fundamental a variation in astronomical thought strongly suggests a change in the ruling race and religion. The rise of the Nile is related to the season of the summer solstice; that of the Tigris and Euphrates to the season of the spring equinox. Have we here, the author asks, an indication of two races which expressed ideas in the monuments? The suggestion is ingenious. So far as I know, it has not been very hospitably received by experts. It is interesting to note that the temple of the sun at Peking is oriented to the winter solstice; Stonehenge to the solstice of summer; the temple of Solomon similarly to the temple of Isis at the Pyramids;

St. Peter's at Rome so that the sun's rays at the vernal equinox illuminate the high altar, etc., according to Professor Lockyer. The inscriptions of some of the Egyptian temples prove, if proof is necessary, the intention of their builders. Speaking of a pair of obelisks at Karnak an inscription reads, "They are seen an endless number of miles away; it is a flood of shining splendor when the sun shines between the two;" and again, "The sun's disc shines between them as when it rises from the horizon of heaven."

It is to be noticed that if the orientations of the builders were exact, and if the measures and directions determined at the present day are accurate, it is a mere matter of calculation to fix the astronomical date at which a temple was constructed, provided their original intention is known to us. The dates of several of the solar temples can be assigned with considerable accuracy in this manner. If we should find, as in fact we do find, says Professor Lockyer, that the builders of set purpose have slightly altered the direction of the axis of a temple during its construction, this will be a sign to indicate that the celestial body related to the temple has changed its direction during the period, perhaps several centuries, of construction. It is upon facts of this kind that Lockyer bases his proof that some of the temples are related, not to the sun, but to stars. This is the key-note of the book. The change of direction of the axis is not to be explained by a change in the sun's direction, but demands another interpretation. The situations and arrangements of the principal stars were well known to the inhabitants of the Nile Valley. We have seen that many of the Egyptian temples are oriented to solar positions. There are many temples that cannot by any possibility be so oriented. They are built so that no ray of sunlight can pass along their axes at any period of the year. The question arises, are these temples oriented to stars? or, again, are they oriented at all? Are their directions assigned by chance? The topographic conditions of the sites seem to show, in a number of cases, that their builders had a set purpose in facing them as they are faced. If the direction of their walls had no significance they would, it seems, have been differently placed. The latter half of the volume under review is devoted to these questions, namely: Were such temples oriented to a star? to what star? and at what epoch were these monuments constructed?

Every detail of construction goes to show that this group of (stellar) temples was built to receive a horizontal ray of light along the axis just as the solar temples were. A striking fact in this connection is that the (stellar) temples frequently exhibit a change of direction of the principal axis, such as calculation shows would be necessary to allow for changes in the direction of stellar beams every few centuries. A solar temple does not require such changes of axial direction. "Once a solar temple, a solar temple for thousands of years; once a star temple, only *that* star temple for something like three hundred years." If after some three centuries the stellar light no longer penetrated the temple a change of direction of the axis would be required. It is just such changes of direction that have been found.

The foregoing summary is believed to represent with fairness the *method* adopted by Professor Lockyer, and to indicate, at least, his main conclusion, namely, that many of the Egyptian temples have stellar relations and were oriented so that the horizontal rays of Capella, *Gamma* Draconis, etc., etc., might fall along their axes at the time the buildings were constructed. The latter half of the book is given to a detailed proof of the stellar relations of the temples, and it deals not only with architectural measurements and astronomical computations, but with recondite questions of mythology, history and ethnology. To the writer of this review it seems that the chief merit of the book is to have called attention to a most important province of the history of the growth of astronomic notions (and thus of religious ideas) and to have set forth in plain and popular form the obvious method of research which must be resorted to. It seems that further research is called for. It may lead to certain and definite results. The present volume can hardly be said to have proved all its points. To judge it completely one should be historian, ethnologist and astronomer in one; but one need be no more than a

humble logician to point out various flaws in the argument.

I believe the Egyptologists do not accept the Zodiac of Denderah and the inferences of Biot as unreservedly as Professor Lockyer. The ethnologists will, I understand, raise many objections to Professor Lockyer's hypothesis of a change of race and religion. Mythologists will surely rebel against his treatment and interpretation of myths. Astronomers will point out how *many* stars there are and how few temples, so that it may not be so very difficult, given several hundred years of leeway, to choose a star to fit a temple. Plain people will ask how it is that a temple is, so to say, dedicated to one star and oriented by another. Sirius was the *star* related to Isis, Mut and Hathor. But the temples of these deities are not invariably oriented by Sirius. *Gamma* Draconis is a rather faint star. Why were not brighter ones selected?

After raising these objections and a crowd of others that might be brought forward, it remains that Professor Lockyer's book is a contribution of high value and merit. A question of importance has been plainly put. The method of solving it has been described in popular language. The data now available has been brought to the notice of everyone. If Professor Lockyer has done little more than this, and if his principal conclusions still call for further confirmation, he deserves the thanks of all concerned in these questions—and who is not?

EDWARD S. HOLDEN.

Song Birds and Water Fowl. By H. E. PARKHURST. New York, Scribners. October, 1897. Illustrated by Louis Agassiz Fuertes. 12mo, pp. 286. Price, $1.50.

If there is any truth in the law of supply and demand, the present flood of popular bird literature must be taken as evidence of an extraordinary if not unprecedented interest in the subject of birds and nature. It is a healthful interest and one which awakens and develops some of the better elements in our natures which are apt to lie dormant.

Mr. Parkhurst's 'Song Birds and Water Fowl' is not intended as an aid to the identification of specimens, but belongs rather to the class of popular nature studies. A fair idea of the contents may be had from the chapter headings, which are as follows: A Boquet of Song Birds; Water Fowl; A Bird's-Eye View; Mistress Cuckoo; Sea Swallows; Bird's Nests; At the Water's Edge; Lake George; A Colony of Herons; Earliest Signs of Spring.

The book is illustrated by eighteen admirable full-page drawings by Fuertes.

C. H. M.

Birdcraft, a Field Book of Two Hundred Song, Game, and Water Birds. By MABEL OSGOOD WRIGHT. New York, The Macmillan Co. November, 1897. With 80 full-page plates by Louis Agassiz Fuertes. 8mo, pp. 317. Price, $2.50.

The second edition of Mrs. Wright's 'Birdcraft' is a pleasant surprise. The cheap chromos of the first edition are replaced by a colored frontispiece and eighty full-page halftone plates from original drawings by Fuertes, the powerful young bird artist who has so suddenly sprung into fame. Most of these drawings have recently appeared in 'Citizen Bird,' by the same author and Dr. Elliott Coues (noticed in SCIENCE of November 5, 1897, p. 706).

Since the text of the second edition of 'Birdcraft' is printed in the main from the same electrotype plates as the first, it is only necessary to refer to the review of the former (SCIENCE, June 7, 1895, p. 635), with the additional statement that the principal errors there mentioned have been corrected. The book in its present form is attractive, interesting and helpful and should be in the library of every lover of birds.

C. H. M.

Magic Stage Illusions and Scientific Diversions, Including Trick Photography. Compiled and edited by ALBERT A. HOPKINS, with an introduction by HENRY RIDGELY EVANS. New York, Munn & Co. 1897. With four hundred illustrations. Large 8vo. Pp. 556. Price, $2.50.

The associations of the term magic are hardly suggestive of scientific processes or principles; they are more apt to call up an atmosphere of mystery and secret knowledge, a world of the

unexpected and the unfathomable. But the magic of to-day bears quite as conspicuously as many of the applied arts and crafts the marks of the laboratory and the research room. Nineteenth century magic reflects the evolution of nineteenth century science and can look back with an air of condescending amusement or curious interest upon its old-time antecedents, much as the modern chemist reads the annals of alchemy or the superbly equipped astronomer contemplates the vagaries of the medæival astrologer.

There is, indeed, much to interest the student of science in the elaborate performances of the prestidigitateur and the illusionist; and the interest is two-sided, physical and psychological.

The physical interest centers in the description of the true *modus operandi* of the tasks and the accompanying paraphernalia; the psychological interest in the method of arousing false perceptions and inferences and producing the conviction that the impossible has happened. The student of the psychology of deception takes his place with the audience and observes how readily their attention is diverted at critical moments, how easily they overlook the apparently insignificant but really essential settings of the trick, how the bewilderment increases and the critical faculties lapse as one bit of sleight-of-hand succeeds another. The student of the curious and intricate applications of science must be stationed behind the scenes and observe at times how simple a contrivance evades detection, or, again, how an elaborate combination of mechanical principles is ingeniously applied to produce a startling effect. The main lesson which the psychologist takes away is the importance of the attitude in creating belief, the dominance of cleverly suggested expectation in our sense experience, the readiness with which we substitute inference for observation and go away convinced and deceived. The physicist or the mechanician is quite certain to be impressed with manifold possibilities of mystification which the rapid increase of science brings in its train.

This ably compiled volume will appeal to both types of readers as well as to the more popular interest in mysteries and the processes of deception. It is wide in scope, treating of conjuring tricks of all varieties; of jugglers and fire-eaters; of puppets and shadow dances; of ventriloquism and second sight; of the application of science to stage effects and cycloramas and fireworks; of automatic and scientific toys; of the kinetoscope and the vitascope, and the varied applications of photography; and in addition to all this some interesting information upon the conjuring tricks and performances of olden times. The tone of the descriptions is clear and the volume is well adapted to satisfy the needs of the somewhat heterogeneous class of readers who are likely to consult it. Moreover, the book is distinctly modern, and avoids both the unnecessarily popular and frequently irrelevant style of much of this kind of literature. It comes as nearly within the pale of science as any book with this kind of a purpose can be expected to reach. A valuable bibliography and index add much to its usefulness.

JOSEPH JASTROW.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES—SECTION OF BIOLOGY—NOVEMBER 8, 1897.

THE meeting was called to order by Professor Wilson, the Chairman. Twenty-two persons present. After reading the minutes of the previous meeting, the following program was presented:

Mr. Matthews reported on analyses of spermatozoa in Kossel's laboratory, Marburg. Sperm of *Arbacia*, herring, pig and bull were examined. Herring sperm heads were separated from the tails by Meischer's method, and made free from albumen. They consisted of protamin nucleate, having the formula $C_{40}H_{54}N_{14}P_4O_{27}$, $C_{30}H_{57}N_{17}O_6$. The nucleinic acid appeared identical with that of salmon sperm (Meischer), although the protamin differed from salmon protamin, as shown by Kossel. The sperm tails consisted chiefly of a combination of lecithin, cholesterin and albumen, similar to, but not identical with, similar constituents of salmon sperm tail. The tails contained no nuclein. The heads contained no lecithin nor cholesterin. *Arbacia* sperm contained nucleinic acid, but no protamin, instead of which a histon-like body was present. It is probable that *Arbacia* sperm chromatin is an histon nu-

cleate and more complex than fish-sperm chromatin. Neither bull or pig sperm contain protamin. The author suggests that the simplicity of fish-sperm chromatin is difficult to reconcile with Weismann's hypothesis.

Dr. Bashford Dean, in 'Notes on *Palæospondylus*,' gave a brief reply to Dr. Traquair's recent objections (Pro. Zool. Soc. Lond. March 16, 1897). The author notes:

(1) That the radial-shaped markings of the type specimen are certainly part of the fossil, since they occur in a second specimen now in the possession of Professor Stratford.

(2) That his broader interpretation of the 'unpaired nasal opening' (Traquair) as a naso-mouth ring (as in *Myxine*) was an independent as well as a necessary one, as will appear in the full paper.

(3) That the view of the presence of the radial-shaped markings as the probable supports of paired fins, the relations of *Palæospondylus* to the Marsipobranchs, become even more hypothetical.

Dr. Matthew reported on the status of the Puerco fauna. A review of the Puerco fauna, based on Dr. Wortman's geological observations in the field and the records kept by the American Museum collecting parties, shows that the Upper and Lower Puerco beds do not contain a species in common, and only three or four genera pass through. The two faunas are entirely distinct. Dr. Wortman proposes to call the upper beds the Torregon formation, retaining the name Puerco for the lower beds.

Mixodectes, formerly supposed to be a primate allied to the modern *Chiromys*, is a true Rodent in the first stage of evolution. It has the characteristic Rodent astragalus, very like that of the earlier Sciuromorphs. The incisor is intermediate between the short, rooted spatulate incisor of most modern mammals and the long, rootless scalpriform incisor of the Rodentia. The root is long, but does not grow from a persistent pulp, and the crown is long and pointed, but still retains much of the spatulate shape. The canine and anterior premolars are disappearing, the fourth premolar becoming molariform, and the molars showing some traces of an impending change to a type like that of the Wasatch rodents.

More complete material of many species shows that all the placental mammals were remarkably similar in skeleton structure. They were plantigrade, pentadactyl, with claws or narrow hoofs, short, clumsy limbs and long, heavy tail. Contrary to expectation, the podium and metapodium are not usually arranged in serial order. The carpus is alternating in the four species in which it is known, and the tarsus is serial in only two out of eleven species. Of these two, one is a primate, the other is the ancestor of *Phenacodus* and has an alternating carpus. The direct ancestors of the Perissodactyls and Artiodactyls do not seem to be among the known Basal Eocene species. The Creodont *Clænodon* resembles the modern bears in foot structure as well as in the teeth, and may have been ancestral to them. Considering that such widely different types as the Edentates, Rodents, Primates and Amblypods have been traced to their first beginnings in the Basal Eocene, it may be concluded that the first differentiation of all the Placental mammals took place at the beginning of the Tertiary and not in the Cretaceous as has frequently been stated. Dr. Matthews' paper was discussed at length by Professor Osborn and Dr. Wortman.

Mr. Harrington reported on some observations which he had made on 'Earth Worms during Copulation.' He described an organ which apparently had been usually overlooked. This organ, the spermatophore of some authors, consists of a modified seta, much enlarged at the extremity and functioning, as Mr. Harrington suggests, to force spermatozoa into the seminal receptacles of the other worm.

GARY N. CALKINS,
Secretary of Section.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of St. Louis on the evening of November 15, 1897, Professor F. E. Nipher presented informally some of the results of recent experiments on the stability of a pivotally mounted sheet in an air stream, his experiments having been performed by exposing the pressure planes on the roof of a moving box car.

WILLIAM TRELEASE.
Secretary.

SCIENCE

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FRIDAY, DECEMBER 10, 1897.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*THE REVIVAL OF ALCHEMY.**

"Superfluous rehearsalls I lay asyde,
Intendyng only to give trew informatyon
Both of the theoryke and practicall
operatyon;
That by my wrytyng who so will
guyded be,
Of hys intente perfyctly speed thall he."
GEORGE RIPLEY (1471).

FRAUD, folly and failure have been deeply written into the annals of alchemy in all ages; it was early characterized as an 'art without art, beginning with deceit, continued by labor and ending in poverty,' and in modern times its extravagant pretensions have been condemned by an exact and critical science, yet notwithstanding there are to-day indications of a resuscitation of the captivating theories and of renewed attempts at their practical application, of great interest to students of the intellectual vagaries of mankind.

Belief in the possibilility of prolonging life by an artificial elixir and of transmuting base metals into silver and gold was generally entertained in the Middle Ages, not only by the ignorant masses, but even by serious-minded philosophers imbued with all the learning of the time; and the popular faith was sustained by the tricks of unprincipled impostors who found it profitable to prey upon the credulity and avarice of their fellow men. Those who in

* Read before the New York Section of the American Chemical Society, October 1, 1897.

modern times have written of alchemists find in the extravagant views of a Paracelsus, and in the careers of a Flamel, a Sendivogius, or of a John Dee, more entertaining materials than in the abstract conceptions of sober philosophers, and consequently most readers are more familiar with the misdeeds of adventurers than with the honest beliefs of respectable men of science. Before condemning those who labored day and night to solve the problems of transmutation and the elixir of life we should consider their intellectual environment; superstitious beliefs of every kind prevailed; even the sciences were in bondage; astronomy was dominated by astrology; medicine was influenced by magic; natural history was subject to blind belief in authorities, and scientific chemistry was entirely overwhelmed by the chimeras of alchemy. Kepler and Tycho Brahe, at the Court of Rudolph II., did not think it beneath their dignity to cast horoscopes for gain and to predict the future by consulting the positions of celestial bodies, even while formulating the laws governing their motions. European crowned heads retained astrologers and alchemists as members of their courts. A century later Sir Isaac Newton dabbled with furnaces and chemicals in true hermetic style; and Leibnitz showed the courage of his convictions by acting as Secretary of an Alchemical Society in Germany. The influence of superstition on the mental attitude of truly great men decreased with the advancement of learning, and when the foundations of scientific chemistry were laid by Priestley, Lavoisier, Scheele and their contemporaries, the doctrines of alchemy were abandoned. And yet not wholly abandoned, for there seems to have been a small number of persons in all countries who have clung to the hope of realizing transmutation, a hope sustained by the desire to reap the golden reward. This minority rejected the extravagant belief in a life-prolonging elixir, and in the divine origin of the profound secrets of the initiated, and sought to appropriate from the growing sciences such discoveries and theories as could be interpreted in favor of transmutation.

The printing press has never ceased to issue works devoted to the subject. Some authors have written of a 'higher chemistry,' and others have sought to reconcile the new doctrines of chemists with the ancient theories of alchemists. As recently as 1832 a German professor wrote a learned volume with the avowed intent of proving the verity of transmutation from historical sources (*Schmieder's Geschichte der Alchemie, Halle,* 1832). The number of reprints of the grotesque writings of reputed adepts which have appeared since chemistry has become an exact science is surprisingly large, and the fact that they find purchasers indicates a small but zealous class of hermetic students. So eminent a chemist as Sir Humphry Davy did not hesitate to affirm that some of the doctrines of alchemy are not unphilosophical.

Recent discoveries in physics, chemistry and psychology have given the disciples of Hermes renewed hopes, and the present position of chemical philosophy has given the fundamental doctrine of alchemy a substantial impetus; the favorite theory of a *prima materia*, or primary matter, the basis of all the elementary bodies, has received new support by the discoveries of allotropism of the elements, isomerism of organic compounds, the revelations of the spectroscope, the practical demonstrations by Norman Lockyer, the experiments on the specific heat of gaseous bodies at a high temperature by Mallard and Le Châtelier, the discoveries of Sir William Crookes as set forth in his monograph on 'Meta-elements,' the discovery by Carey Lea of several singular allotropic forms of silver, and, most

weighty of all, the mass of related facts and phenomena which find their ultimate expression in the Periodic Law of the Elements, so that many chemists of the present day are inclined to believe in the mutual convertibility of elements having similar chemical properties. Daniel Berthelot, in his notable work entitled 'De l' allotropie des corps simples,' boldly affirms his belief in the unity of matter. He says: "Without seeking to find in any one of the known elements the generator of the others, can we not invoke the facts that we have revealed in our study of carbon, in favor of the hypothesis of a unique matter unequally condensed?" And elsewhere he writes: "The transmutation of an element is nothing more than the transformation of the motions which determine the existence of said element, and which gives it special properties, into the specific motions peculiar to the existence of another element."

Simultaneously with the development of the truly scientific aspect of alchemical theory, there has arisen an extraordinary revival of the metaphysical side of the question; this goes hand in hand with the interest in chiromancy, astrology, theosophy and occult sciences which occupy so large a place in modern thought, literature and polite society on both sides of the Atlantic. This tendency to cultivate the esoteric manifests itself in the study of the Kabala, the investigation of the mysteries of Buddhism, Confucianism and other oriental philosophies, in researches into the phenomena of spiritualism so-called, and in the foundation of societies to study Psychic Force and the tenets of the followers of Madame Blavatsky; crystal-gazing, reading in magic mirrors, slate-writing, planchette, the quasi-scientific study of apparitions, of table-turnings, of rappings by unseen powers, of telepathy, of subliminal self, are now regarded as legitimate pursuits in no wise necessarily associated with the black arts of mediæval times, provided only they are conducted in a spirit of enquiry and for the purpose of discovering the latent power underlying these phenomena. And this line of research receives stimulus from the results secured by students of experimental psychology, of hypnotism, from such discoveries as the phenomena of the X-rays, and from the transcendental physicists who theorize on the miraculous consequences of four dimensional matter. Crowded lecture halls reward exhibitions of trance mediums, speakers on theosophy, palmistry and occultism; in lower walks of life fortune-tellers and clairvoyants reap a modest harvest; books treating of occult themes enjoy great notoriety; writers of fiction find it profitable to introduce the mysterious into the children of their brains; even secular journals, especially those of France, give space to the all-absorbing discussions on hermetism; these are some of the evidences of great popular interest in the unknowable. Only persons with special intellectual equipment are able to measure, weigh, sift and coordinate the novel phenomena gathered by researches in the field of hypnotism, psychology and occultism; those of weaker mental powers fail to perceive the real significance of the discoveries and are led away into unprofitable and dangerous superstitions.

In the Middle Ages alchemy was nurtured by ignorant superstition; now it is fostered by the prevalent devotion to esoteric studies; formerly the popular belief was in part supported by the fraudulent claims of impostors; now a higher standard of intelligence rejects the transparent tricks of imitators of Cagliostro. There are, indeed, occasional attempts to swindle the credulous by appeals to avarice; we read in the daily press of an American confidence-man who tried to cheat a London jeweler by pretending to 'multiply' sovereigns; of a

vulgar scheme of fraud among ignorant tradesmen on the east side of New York City, in which lead, iron scraps, crucibles and furnaces formed the properties; and of the larger operations of an educated French chemist who found dupes in both South and North America; but in each of these cases the severe logic of law courts intervened and abruptly discomfited the swindlers. It is not by sleight-of-hand that the revival of alchemy is now being engineered, but by a company of educated charlatans.

The movement to resuscitate alchemical doctrines and practices has been particularly successful in France, where there are to-day four societies and a 'university' claiming to possess occult knowledge of hermetic mysteries; these secret societies are named: 'Ordre de la Rose-Croix, 'L'Ordre Martiniste,' 'La Société d' Homéopathie Hermétique' and 'L' Association Alchimique de France.'

The first two of these societies seem to work on lines similar to Free Masonry, and claim that their secret mysteries were bequeathed by the last sages of Atlantis and by the Lemures to their brethren in Asia and Egypt, dwellers in sanctuaries whence issued Krishna, Zoroaster, Hermes, Moses, Pythagoras and Plato. The priestly Magi who preserved this lore in the temples of Thebes, Heracleopolis, Aphrodite, Pthah and Serapis were succeeded by secret alchemical societies of the first centuries of our era; then followed the Hermetic lodges of the Arabs, and these gave rise to the Templars, the Rosicrucians and the Martinists.

The third society cultivates especially occult therapeutics, a system of medicine invented in the sixties by Count Cæsar Mattei, of Bologna, which unites the principles of Hahnemann with those of the Iatro-chemists, disciples of Paracelsus. This new departure in medicine publishes four monthly organs and special treatises all its own.

The Alchemical Association of France is successor to the Société Hermétique, which was founded by the late Albert Poisson († 1894), also known by the pen-name *Philophotes.* Its seat is in Paris; the objects of the Association as set forth in its Constitution are "the theoretical and experimental study of evolution and of the transmutation of bodies. Its members, with this end in view, study the processes of the ancient alchemists and compare them with the work of modern chemists." These objects are to be accomplished as follows: "The Association proposes to assist in reviving the unitary doctrines of chemistry: 1st, by grouping the efforts of isolated workers by means of *L'Hyperchimie;* 2d, by furnishing them the aid of advanced students; 3d, by supplying so far as possible books and apparatus to its members. Researches of the members, when approved by the Masters, should be forwarded in duplicate to the Secretary-General; one will be printed in *L'Hyperchimie*, and the other will be preserved in the archives of the Association for the benefit of members who can secure it on demand." "Candidates for admission must pass an examination in: 1st, the theory and history of alchemy; and 2d, the elements of physics and of chemistry (without mathematics). A diploma from a normal, polytechnic or industrial school will be accepted in place of No. 2."

The affairs of the Association are controlled by the Secretary-General, F. Jollivet-Castelot (of Douai), assisted by seven Councillors, who hold an annual meeting. There are at present (July, 1897) two Honorary Members, Camille Flammarion, the popular writer on astronomy, and August Strindberg, a Swede residing in Austria, author of several hermetic essays.* There are two other classes of members,

* Dr. Stephen H. Emmens, of New York, has been added to the list of honorary members since writing the above.

masters (*maîtres*), who are chosen from the ordinary members by the Council after an examination of their writings; and ordinary members (*membres adhérents*), of which the number is unlimited. Modest dues entitle the members to the organ of the Association, *L'Hyperchimie*, a monthly review of alchemy and hermetism founded in 1896.

The Councillors of the Alchemical Association have combined with the active members of the other Societies named to establish a *Université Libre des Hautes Études*. At present this includes three Faculties:

I. Faculté des Sciences Hermétiques, of which the Association Alchimique forms a section. The director of this Faculty is Dr. G. Encausse, and the course of instruction embraces the study of the *Tarot*, alchemical philosophy and practice, occultism, mysticism, Hebrew, etc.; the curriculum leading to the 'baccalauréat-en-Kabbale' is under the supervision of the Group of Esoteric Students, while candidates for the degrees of master and doctor are under the direction of the Martinist Order.

II. Faculté des Sciences Magnétiques, represented by the École de Magnétisme de Paris, and under the direction of M. Durville; it has branches at Lyons, Bordeaux and other cities.

III. Faculté Spirite, comprising several sections of Spiritism.

Each Faculty preserves complete independence, being 'united only by moral bonds destined to hasten expansion of the rational spiritualistic movement.'

The nature of the instruction given at this University will appear in the review of the philosophy of its promoters.

The leading spirits in these secret societies and in this University are as follows: F. Jollivet-Castelot, Secretary-General of the Alchemical Association, special delegate to the Supreme Council of the Martinists, editor of *L'Hyperchimie*, and author of 'Comment on devient Alchimiste,' 'L'Hylozoisme' and other alchemic treatises; Dr. M. H. E. Lalande, whose pen-name is *Marc Haven*; F. Ch. Barlet, author of 'Essai sur l'Evolution de l'Idée;' Dr. G. Encausse, who generally conceals his identity under the signature *Papus*, is President of the Esoteric Group,* President of the Supreme Council of the Martinists and the author of sixteen treatises on hermetism and magic, among which may be named 'Traité élémentaire de Magie Pratique.' Papus is also editor of *L'Initiation*, a journal devoted to theosophy, magic and occultism, and of *Le Voile d'Isis* a weekly review of spiritualism. Stanislas de Guaita is best known as the author of 'Le Temple de Satan,' 'Clef de la Magie Noire,' and 'Le Probleme du Mal,' works dealing with sorcery, the astral light in man and other mysteries. Marius Decrespe's essay on 'Les Microbes de l'Astral,' Paul Sédir's 'Les Incantations' and Albert de Rocha's 'Exteriorisation de la Motricité' are works which indicate the mental attitude of those engaged in the revival of alchemy and hermetism. A bibliography of this class of works is here out of place; a single trade catalogue enumerates one hundred and twenty titles, chiefly of recent date.

One of the oldest workers in the Alchemical Association is the 'Master' Théodore Tiffereau; in 1854–55 he sent to the French Academy of Sciences six memoirs in which he claimed to have discovered a method of converting silver into gold. Tiffereau had made his experiments in Mexico at great expense, supporting himself meanwhile by taking daguerreotypes. His process was repeated at the Mint in Paris before the as-

* The Groupe Indépendant d'Études Ésotériques has 1,600 members, 104 branches and correspondents. It embraces members of the following societies: Ordre Martiniste, Ordre Kabbalistique de la Rose-Croix, Église Gnostique, Société Alchimique de France. Membership is free.

sayer, M. Levol, but with little success. The substance of his memoirs was published in 1855 in a volume entitled 'Les Métaux sont des Corps Composés;' of this a new edition was published by Lermina in 1889. Tiffereau has never abandoned his claim, and as recently as October, 1896, he addressed another memoir to the Academy, in which he attempts to prove that the metal aluminum is a compound. Briefly stated his process is as follows: He placed in a stout glass tube a piece of aluminum foil with pure nitric acid and sealed the tube hermetically. He then exposed the tube and contents to the sun's rays during two months; at the end of this time he opened the tube; it gave out an odor which he thought was due to ether, and it yielded a few grammes of crystals which he thought tasted like acetic acid. Since both ether and acetic acid are compounds of carbon, Tiffereau concluded that this element was derived from the aluminum. Analytical chemists would criticize this experiment in several points; they would say Tiffereau did not demonstrate the absence of carbon in the metal used, and that he depended upon smell and taste for proofs of the carbon compounds; the tongue and the nose are incontestably useful adjuncts to the reagents of a chemical laboratory, but additional tests for ether and acetic acid would have been more conclusive. In Tiffereau's recent writings he attributes the transmutation of a base metal into the most precious one, to the action of the 'microbe of gold.'

For a student of chemistry to read, digest and write down in intelligible language, in a limited space, the principles of this new school of chemical philosophers is a difficult task, even for one somewhat familiar with the literature of the ancient alchemists; consequently the following analysis falls far short of the ideal. It is properly the work of a kabalist, a theosophist and a magician, proud designations which the writer disclaims. The modern alchemists accept all the traditions of their ancient predecessors, but give them a new significance, and interweave the novel phenomena derived from researches in pure science. They claim that during the fourteenth, fifteenth and sixteenth centuries the official schools of instruction taught exclusively the physical part of the sciences, and that the metaphysical part (which is the real life and soul of the study) has been rejected under the opprobrious name of occult science. This living aspect of science has, however, been studied in the secret societies of the initiated, which have preserved the traditions of the kabala, the mysteries of hermetism and the practice of transmutation. The study of science is as much a religious question as an intellectual one, and worship at an altar should sustain and enlighten the worker in a laboratory. 'Chemistry, alchemy and hermetic philosophy form three steps of the ladder which leads the initiated from the laboratory, through artistic realization, to the oratory: '*Labora, Opera, Ora et Invenies.*' "

The modern alchemists also maintain that Darwin and his disciples appreciated but a small part of the great doctrine of evolution, which should be applied to the chemical elements as well as to living beings. The starting point in the evolution of elements is the ether (the universal astral fluid of the kabalists), the infinitely divisible particles of which form chemical atoms by agglomeration. This ether is condensed energy, and hence all matter is resolved into energy.

Energy, matter and motion form a trinity analogous to the Divine Trinity, one in substance, three in appearance. Matter is one in kind, and the diversity of chemical bodies results from differences in grouping and in motions of the constituent particles. Intelligence is allied in a mysterious way

with matter and energy, forming another trinity. Every atom centralizes intelligence, is in itself a living entity and by a process of self-evolution yields the diverse natural bodies. "Ether is the father of hydrogen, from which are derived oxygen, nitrogen, carbon, etc., combinations due to etheric vortices." "Perhaps helium should precede hydrogen." This view of matter as a living entity is greatly insisted on, and the doctrine is called *Hylozoism.* An alchemist who expects to succeed must possess psychic power over the atoms, so that by the action of his will they shall group themselves to form the metal desired.

Such is the physical philosophy of modern alchemists; the kabalistic philosophy is by no means so clear, being closely linked to the *Tarot*, which signifies the 'hieroglyphs and algebraic calculations of the Primordial Genesis.'

Students of the mystical philosophy of the Hebrews discover profound occult significance in accidental similarities of widely differing objects and phenomena. The seven planets, seven days of the week, seven colors, seven orifices in the head, seven metals known to the ancients, seven archangels and seven infernal demons present to the truly kabalistic mind marvellous and precious analogies. In the 'Table of Concordance of Major Arcana' these correspondences are given: 'Heth–Justice–Elementary existence–Nizah–Cancer–June–Hydrogen–Fire.'

Jollivet-Castelot has written of Kabalistic Alchemy, and a perusal of his essays leaves in the mind of the uninitiated confused memories of colors, numbers, signs of the zodiac, alchemical operations as distillation, fixation and the like, the names of the sons of Jacob, certain precious stones, geometrical figures, Hebrew characters, Azoth, quintessence and the Devil, all discussed in a language as obscure as the symbolism portrayed. To conceal esoteric mysteries abbreviations are often used, but one does not have to be very deeply initiated to recognize in P.·. Ph.·. 'pierre philosophale,' and in G.·. O.·. 'grand oeuvre.'

Astral light is an important factor in modern hermetism, and is related very closely to the 'radiant matter' of chemists and the 'ether' of physicists. "Astral light is the universal agent, the universal plastic mediator, the common receptacle of vibrations of motion and of the phantoms of form." It is also the Od of the Hebrews and of Baron von Reichenbach; it is the great Thelesma of Hermes Trismegistus, and the control of this force constitutes the great arcana of practical magic. It heats, illuminates, magnetizes, attracts, repels, vivifies, destroys, coagulates, separates, crushes and gathers all things under the stimulus of powerful wills; it is a perpetual and transformable vibration. Its kabalistic figure, represented by the Serpent of Theogonies, is:

$$\begin{aligned} \text{Od} &= + \\ \text{Ob} &= - \\ \text{Aour} &= \infty \end{aligned}$$

When the universal light magnetizes the universe it is called astral light; when it forms metals it is called *Azoth*, or the Mercury of the Sages; when it gives light to animals it is called animal magnetism. The astral undulations determine the position of the atoms or neutralize them. Herein lies the secret of transmutation, and it becomes the privilege of the hermetist to acquire the power of controlling this agent.

The adepts in this phase of hermetism still appeal to the *Tabula Smaragdina* of Hermes Trismegistus as the embodiment of alchemic lore. The 'Father of Alchemy,' who has been identified with Canaan, Noah's grandson, invented arithmetic, geometry, astronomy and music, taught writing to the Egyptians, and gave laws and religious rites to the people; he was

perfectly acquainted with the 'philosophers' stone,' and, desirous that posterity should inherit the wonderful secret, he had the whole art of creating gold engraved on an emerald tablet, which was placed in his sepulchre. Many years later this was removed by Sarah, Abraham's wife, and she concealed it in a cave near Hebron; there it remained until again discovered by Alexander the Great. The inscription reads in part as follows:

"I speak not of fictitious things, but of that which is most true and certain. Whatsoever is below is like that which is above, and that which is above is like that which is below, to accomplish the miracles of one thing. Also since all things were made from one by the help of one, so all things are made from one thing by conjunction. The Father thereof is the Sun and the Mother thereof is the Moon; the wind carries it in his belly, and the nurse thereof is the earth. * * * This thing has more fortitude than fortitude itself, because it will overcome every subtile thing and penetrate every solid thing. By it this world was formed. Hence proceed wonderful things which in this wise were established. For this reason I am called Hermes Trismegistus, because I possess three parts of the philosophy of the whole world. What I had to say about the work of the sun is completed."

Writers on modern alchemy discuss the marvels of palingenesis, of homunculi, and of gamahes; they write of the materialization of a metal through the medium (mediumnité) of a metal; they cite the 'Rules of Philalethes,' the works of George Ripley and of the Cosmopolite, and refer in the same essay to Berzelius, Berthelot and Moissan. We are told that "*le diable est le singe de Dieu*," and that the "Cherubim of the Ark of the Covenant symbolizes the male and the female of the Universe, the Alchemical Father and Mother," by the very authors who show acquaintance with the most recent advances in pure chemistry. In liquid fluorin they perceive a realization of the Alkahest, or universal solvent long sought by mediæval alchemists.

Accustomed to juggle with numbers, the kabalist finds abundant opportunity in the atomic weights of the elements, and he makes the most of his opportunity. When the arithmetical sum of the atomic weights of elements entering into a given compound chances to equal the atomic weight of gold, this accidental correspondence is seized upon as a pretext for claiming hermetic relationship between the two substances.

August Strindberg has devoted much study to such correspondence and points out the following:

$$K_2MnO_4 = 197 = Au$$
$$Cu_2Cl_3 = 196 = Au$$
$$Fe_3S = 197 = Au$$
$$C_2H_5I + \tfrac{1}{2}\,Br = 197 = Au$$

He uses both 196 and 197 as the atomic weight of gold to suit his purposes, and seems to be very weak in arithmetic, for the hypothetical body Fe_3S has a molecular weight of 200.

The ammonium-ferrous-sulfate crystallized with six molecules of water, which chances to have a molecular weight equal to that of gold, is used by Strindberg as basis of the following experiment, which serves to show his method of reasoning and of operating.

Ammoniacal sulfate of iron = 392 = Au is perhaps the solution of the enigma; sulfate of iron (green copperas), precipitates solutions of gold; to precipitate according to monist-chemistry is to enter as a factor into the reconstitution of the body of a compound. Soak a strip of paper in a solution of sulfate of iron, and expose to the fumes of ammonia; the paper will assume a bluish-green color like that of the protoxid of gold. Dry the strip of paper over

a lighted cigar and the paper will acquire a chestnut-brown color like that of the deutoxid of gold. Little by little metallic flakes of a golden yellow color appear, forming a non-solid (*non-fixé*) gold, when the sulfate of iron produces an auto-fecondation by self-precipitation. However, the golden flakes amalgamate with mercury, which property is not shared by iron. After showing by appropriate tests that iron is still present the hermetic chemist proceeds to explain the reaction by assuming the formation of the hypothetical $Fe_3S = 196 = Au$, or of the imaginary compound

$$Fe_2O_3 + 2H_2O = 196 = Au,$$

or of the

$$\text{ferrous-ammonium-sulfate} = 392 = Au_2;$$

and he adds, 'The chlorid of gold is reduced by the nicotine of the cigar.' Since, however, no reagent containing chlorin in any form was used in the experiment, this element must have been created at the same time with the gold, which, however, is 'incomplete' gold soluble in unmixed acids.

A preacher should never be judged by a single sermon, and to do justice to these nineteenth century alchemists, one more 'recipe for gold' may be transcribed. "Put into a crucible layers of sheet iron and of powdered vitriol; place over it another crucible pierced with a hole for respiration. Heat in an intense fire. But a flux must be added to the crucible to prevent melting, viz: One kilo litharge, one kilo clean white sand, mix and add to the crucible at a red heat. Remove with an iron spoon the yellow oil and put it aside. The two compounds have not lost weight. This oil is dry water, a fire, a salamander. * * * You obtain a metal of a golden yellow, having a density of 24, not capable of being minted. This is changed into ordinary gold." With the exception of a few unimportant sentences, this is the entire recipe, but how the final transformation is to be effected is not given.

To acquire knowledge and power for successful hermetic labors, to become eligible for initiation in the occult societies, is no easy task. The aspirant must strive valiantly against the passions that assail him, casting out of his soul pride, anger, jealousy, hatred, avarice, hypocrisy, idleness. If the candidate for honors desires to become worthy of the name hermetic philosopher he must prove himself a Magian; he must learn to exercise his will on matter in all its forms, and to acquire this power he should practice crystal-gazing and reading in magic mirrors; to learn to perceive the invisible he must withdraw from the visible, imposing on himself psychic sleep, called by some hypnosis. As adjuncts to the attainment of the ideal mental state he should use perfumes, music and light; and eventually the astral body, separated from the physical body, will supply the intellectual, moral and material illumination indispensable to the Great Work.

It is rather discouraging to learn that, even after fulfilling all these hard conditions, no one can realize the perfection desired until he has passed through several of our planetary existences. The would-be alchemist must also follow the percepts of Albertus Magnus; he should be discreet, silent, and must not reveal the result of his labors; he must reside in an isolated place and choose the time and the hours for his tasks; he must be patient, assiduous and persevering, and he must be rich enough to bear the expenses of his pursuit. Besides ordinary chemical apparatus he should provide several objects indispensable to his work, a magic wand, a sword to dissolve the astral coagulations, a magic mirror, a brazier for perfumes, a wooden altar covered with a white cloth, and an alchemist's robe of white linen to be worn with a girdle

embroidered in gold and silver. In all his chemical operations he must project psychic force into the reagents.

Bright prospects for the future of chemical science are claimed by this school of philosophers. Inorganic chemistry is destined to follow the lines in which inorganic chemistry has prospered; the formation, derivation, or rather the evolution of metalloids (so-called) and of metals will be realized through etheric cyclones, different degrees of condensation of hydrogen. Chemical bodies are of one kind only and they are all organic and living.

There is a growing belief among advanced chemists in the theory that the elementary bodies as known to us are compounds of a unique primary matter (*protyle*), and that transformation of one kind into a similar one is not beyond the bounds of possibility, but we do not think that the modern hermetists are pursuing the right path to accomplish this end; nor do we believe that the world of science is any nearer the coveted goal of alchemical avarice.

The revival of alchemical pursuits in France finds concurrent sympathy in other parts of the world. Especially does this pseudo-art flourish in India, where the Sannyassis, a caste initiated in occultism, practice the transmutation of tin, zinc, copper and mercury into silver, or at least into a metal resembling silver superficially. In the published recipes for effecting this change arsenic plays a prominent part, a substance used for the same deception by the alchemists of the Middle Ages. In China a belief in alchemy has existed from very early times; reprints of ancient treatises are still for sale, and the experimental phase is quietly studied by semi-educated persons.

In the United States two notable events have occurred within twelve months, one of which seems to threaten financial revolution. A bold claim to manufacture gold of pure antimony has been made by Edward C. Brice, of Chicago; having been refused a patent on his process by the United States Patent Office, he demanded a test to be made, and three assayers of the United States Mint conducted the trial under Brice's instructions. Needless to say, the experiment did not verify the claim; the assayers found that all commercial antimony contains a trace of gold, and that Brice did not even recover the whole of this by his process. Brice's previous record does not bear the full light of investigation, so that this attempt to revive alchemical practice is on a par with many that have preceded it.

Quite different seems to be the equally bold claim of Dr. Stephen H. Emmens, that he has discovered a body intermediate between silver and gold and capable of being changed into gold; this substance he has named *argentaurum*. Dr. Emmens, who is an Englishman by birth, is the author of many books on a great variety of topics; a treatise on logic, another on explosives, several novels and many papers on chemistry, electricity and metallurgy as well as some poems show his versatility. He is a member of several learned societies, and inventor of the high explosive 'emmensite.' Dr. Emmens has established a laboratory for the manufacture of gold from silver by a secret process in which mechanical treatment plays an important part. Since April 13, 1897, he has sold to the United States Assay Office six ingots of an alloy of silver and gold for the gross sum of $954, as proofs of his success in transmutation. This matter having been exploited in the daily press, details need not here be reproduced.

In the United States, where education is so general and a shrewd, calculating, 'Yankee' spirit looks askance at such enticements, alchemy is not likely to flourish; on the other hand, hermetism, the meta-

physical phase of the philosophy seems far more likely to be cultivated by the devotees of theosophy and esoteric studies.

In conclusion, a passage from Lord Bacon: "I was ever of opinion that the philosopher's stone and an holy war were but the rendezvous of cracked brains that wore their feather in their heads."

H. CARRINGTON BOLTON.

WASHINGTON, D. C.

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*SCIENCE IN EDUCATION.**

DURING the year 1895–96 there were in attendance at the colleges and universities of the United States nearly fifty thousand students who were pursuing courses leading to the degree of Bachelor of Arts, and of whom nearly ten thousand received that degree. In the various technological and professional schools there were sixty-six thousand students and nearly or quite fifteen thousand graduates. That is, those students seeking the so-called liberal education were less than forty per cent. of all the candidates for college degrees.

In none of the professional schools, with but few exceptions, is the possession of a college or university degree necessary for admission. A single medical school at the present time requires its matriculates to possess the bachelor degree, and some others will in the near future. In the theological schools a preparatory college education is more usual, but the whole number of theological students in the United States is relatively small, and does not seem to be rapidly increasing.

Nearly one-half of the professional students are those studying medicine, and of these I do not think more than five per cent. are graduates of other courses. Less than that percentage will be found among the engineering students, for reasons that will appear later. The profession of law, which is yet far behind the other professions in its educational requirements, has less than ten thousand students in attendance upon college instruction in our country, not one-third of the number of the medical students, though the members of the two professions in practice are much more nearly equal in numbers. A much larger proportion of arts graduates turn to the legal profession than to any other, in part due to the fact that the educational requirements of the legal profession are, in general, on so low a plane that the earnest young man is not content to enter upon his life's work with so slight a college preparation as it demands; in part because the ordinary college course offers better preparatory training for the legal profession than it does for any other, save the theological or pedagogic.

I am not aware of any statistics of the number of arts graduates among the active members of the professions in America, as a whole, but the number is clearly very small, certainly not one in ten, and I believe that there can be no question but that the percentage is steadily becoming less from year to year.

Our first impressions are that this fact is to be deplored. I believe, however, that it is rather matter of congratulation, inasmuch as it certainly means in the end better preparation for the active duties of life by the great body of professional men.

In no branch of education has there been more active progress than in that of medical education in the United States during the past fifteen years, and in none has there been a larger proportional increase of students. Twenty years ago, with almost no educational requirements for matriculation, nearly every medical institution in this country would graduate the average student after two courses of lectures, the second a repetition of the first, and each of but four or five months' duration. I have known students of average ability to re-

* A presidential address before the thirtieth annual meeting of the Kansas Academy of Science.

ceive the diplomas of some of the most renowned medical colleges of the United States whose entire medical tutelage was comprised within a period of less than one year's extent.

At the present time many require four years of college work, or shortly will, and these college years are often eight or nine months in length and are never less than six. Furthermore, they are not mere repetitions, but are graded from entrance to graduation with constant laboratory practice and frequent examinations. When the course was of but two years' duration more students relatively sought preparation in a more liberal education in the college of arts, for the same reason that seems to actuate many law students. Many of the law schools now require but two years' attendance upon college work and practically only nominal preparation for admission, and the majority of the practicing lawyers of our country have had no college professional training at all. The better colleges are now extending their course to three years, and it is only a question of a short time when the period of college study necessary for the reception of the legal diploma will be equivalent to that of the medical profession.

The modern educational requirements of the medical profession have, I believe, raised it to a distinctly higher plane than that of the law. To use the words of Justice Brewer: "A growing multitude is crowding in who are not fit to be lawyers; who disgrace the profession after they are in it; who in the scramble after a livelihood are debasing the noblest of professions into the meanest of avocations; who, instead of being leaders and being looked up to for advice, are despised as the hangers-on of police courts and the nibblers after crumbs which a dog ought to be ashamed to touch."

But this condition will not last long. The time will soon come when everyone who appears before the bar of justice as an advocate will be a thoroughly educated man or woman. And does this mean that he will be required to have a four years' education in the college of liberal arts? Most certainly not. A four years' course in the law school will be required, whose certificate will carry with it the educational right to admission to the bar, and little or no attention will be paid to the so-called branches of liberal culture.

Conditions have changed much. The greatly increased competition and the greater struggle for existence now render it imperative that the professional man should be better grounded in the principles of his profession than he once was. The great accumulation of scientific knowledge has left the teas, the simples and the boluses for the quack in medicine. The lawyer can not be a politician, a real estate or insurance agent, and, in the intervals of his avocations, do justice to his client. The professional man can not spend much time in purely cultural and æsthetic studies, while his competitors are spending theirs in acquiring a knowledge of how to treat their patients or how to execute a legal document.

The average course in the college of liberal arts does not prepare for the studies of the medical profession, and not many physicians now urge young men to pursue the course in arts as a preliminary to professional training. A part of that time certainly is better spent in the more thorough mastery of the professional education.

The average age of graduation from the college or university at the present time is nearly twenty-three. The ambitious graduate in medicine will desire to give at least one year to hospital practice, or to travel before beginning his more active duties. He is then twenty-eight years of age, and two or three years more will certainly be needed

before he becomes an independent member of society.

And this is not the worst of it. In the profession of medicine, as in all other professions, book-lore or professional lore is only a part of the foundation for successful practice. A knowledge of mankind, of men and women, is more essential than a finished knowledge of his profession. At twenty-seven or twenty-eight a man is too old to acquire this knowledge in the best way; the plasticity of youth is waning, and new habits are hard to form. He must remain more or less controlled by his student habits, out of intimate touch with the great mass of the people and their inner life. And this lack of knowledge of human nature must surely remain as an obstacle to the most useful and successful practice.

President Eliot has said: "The average age of admission to Harvard College at this moment is fully nineteen. The student who stays here four years is twenty-three years old when he graduates. He then goes to our medical school to stay four years; so he is twenty-seven years of age before he has his medical degree, and we all know that some years intervene between that achievement and the competency to support a family. Now, that highly educated young man ought to have married at twenty-five."

The same conditions will surely confront the lawyer before long, and not only the lawyer, but the dentist, the theologian and students of other learned professions.

An answer that is brought as a solution for this unsatisfactory state of affairs is that the fault is in the preparatory schools. That poor teachers and poor teaching make the work of preparation for the college longer than need be, is very true, but I do not think that any relief obtained here will influence students toward the college of liberal arts. As teaching in the secondary schools become better and more efficient, other subjects will be crowded into the high school course, filling in all the time that is saved. This will be of added advantage to the professional student and will more and more tend to lead him away from the college of liberal arts. Furthermore, none of the colleges of the United States have shown much, if any, tendency to shorten the course leading to, or render less difficult the requirements for, the Bachelor of Arts degree.

The entrance requirements for the medical and law schools are at the present time very unsatisfactory. The medical schools have labored unceasingly to increase them for the medical degree, during the past ten years, so far as professional knowledge is concerned, but they have done very little towards increasing the requirements for admission to the schools. In very few schools are they at all equivalent to those for admission to the freshman class in the better colleges of liberal arts. A very little knowledge of some foreign language, usually Latin is required; a little mathematics and a little physics, and a passable knowledge of English; but the student needs very little of what the world calls liberal culture, and practically nothing whatever is demanded.

After considering these chaotic entrance conditions to the professional colleges of law and medicine, it is refreshing to turn to another, in which, with but little pretension, with modesty and deprecation, rather, a model has been set which all the other professions will, in the end, surely follow.

The engineering profession to-day is, upon the whole, the best educated in America. While there may be a smaller proportion of highly trained men, there is also a far smaller proportion of poorly trained ones than in either medicine or law. It may seem strange that that profession which comes less into immediate contact with the general public should be, upon the whole, more highly trained than

those which touch so closely the pecuniary and physical well-being of every one. But the reason is not hard to find. The engineer is judged more by his peers, while the lawyer's or physician's success is dependent very largely upon the public. The capacity of the engineer must invariably be made apparent to men of affairs and ability, while the lawyer or physician is judged, for the most part, by those who are incompetent to determine his real merits.

Undoubtedly, as the years go by, more rigorous requirements will be demanded from the engineer, as from the lawyer and physician, but I do not believe that they will ever be very great in extent, save as new methods of teaching are developed, and these will require ability and capacity rather than time. The engineer may enter upon active life at the age of twenty-four or -five at the outside, fully grounded in the principles of his profession. No gap is left in his education between the high school and his strictly professional course, but the one grades into the other in an harmonious way. Though he graduates with the commonplace degree of Bachelor of Science, it represents, on the average, more college work than does that of Doctor of Medicine.

If, then, the learned professions are drifting away more and more from the college of liberal arts, what is the object of a general college education? What does the average young man or young woman have in view when he enters upon a four years' course leading to the degree of Bachelor of Arts? Undoubtedly the larger number have nothing definite in view. They are actuated, for the most part, by the desire for a better education, without any clear idea of what they wish to accomplish in life. Had the student in the high school a definite conception of his future work in life he would be more apt to seek that special training which would most enhance his prospects for success. Many of the universities and colleges have endeavored to attract those students who have determined upon their life work, and who would otherwise skip the general college course, by offering some choice of studies, or by permitting the last year in the course for the arts degree to be spent in the professional school. This system of optionals has, perhaps, reached its highest development at Harvard and Leland Stanford Universities, where not only great latitude is allowed in the entrance conditions, but the whole college course is made up more or less fully of optional studies. That this system has been popular is shown by the more rapid growth of these and similar institutions as compared with the more conservative institutions, where many of the older classical requirements are yet rigidly insisted upon.

But, the system of optionals has gone quite far enough in some directions, not far enough in others. The average student, who has not yet made up his mind what he will do with himself, is bewildered and confused by the multiplicity of studies opened up before him. He is not competent to judge what is best for himself, and he needs at this time, more than at any other in his life, the advice and assistance of those who have gone before him over those labyrinthine roads; and he rarely gets it. The study of Chinese jurisprudence seems to have as much importance in the college curriculum as do other subjects, and, if the teacher is popular or 'easy,' he selects it. If he is working for his degree, as unfortunately most undergraduate students in the college are, he picks out the 'soft snaps' in college parlance and tries to double up on his studies that he may get through the sooner. Throughout all his preliminary course in the high school, as well as in his freshman and sophomore years, the study of language and mathematics has been strongly emphasized and he has had hardly

a glimpse of any other branch of knowledge. In the name of common sense, then, how can he be expected to have acquired any taste whatever for unrelated and dissimilar studies, or to have any conception of their relative importance? His advisers have been chiefly linguists and mathematicians, whose ignorance of the natural sciences is often equalled only by their prejudice against them. It is a fact that the larger proportion of those who have become students of the natural sciences have had their inclination formed despite of rather than by means of the university. The university seldom intimates to them that science studies ought to form an important part of their general training.

The result of all this desultory or biased study is that the student usually graduates without any clear idea of what he will do in life. He rarely studies with any definite aim, save that of getting an education, of the value of which he has little conception. He has been taught to believe that the best possible preparation for success in any department of life is a liberal education, and he does not trouble himself much as what his future career may be, resting self-satisfied in the delusive assumption that he will be fitted to enter upon anything.

It is true that the most earnest students that we have are those of the professional schools. A distinguished teacher of engineering has said: "It is unquestionably a fact that the engineering students of our colleges do more and harder work for a degree of equal grade than do the students of other departments." As a teacher of medical science I know that the average medical student does fifty per cent. more work than those of like capacities in the undergraduate arts courses. There can be no denial of the fact that the most earnest students are those who seek knowledge as a direct means of success in life rather than for the mere pleasure of its possession.

I believe, therefore, that the principle, now so largely adopted, which permits the student to browse about at his own will with a nibble here and a bite there, is wrong. He should be permitted and required early in his life to gaze upon the broad field of knowledge and at least to taste some of its enjoyments, in order that he may find out what his best and easiest path will be towards success. Away with the mediæval idea that a course in arts fits a man for anything. It does not and never will, unless it changes very much from what it yet is. As we have seen, the degree of Bachelor of Science in engineering, to which we may also add that in pharmacy, represents a larger degree of training and a greater knowledge than that possessed by the Bachelor of Arts. Why, then, does the latter assume such transcendent importance in education? Solely upon the claim of culture. How many are the sins that are committed in thy name! The classical student who has devoted five or six of the best years of his life to the study of the ancient languages, with little or no attention given to the modern sciences, is dwarfed and narrowed in his conceptions of life, even as the scientific student would be with no knowledge of the languages. Horace Greeley meant just such students as these when he said: "Of all horned cattle, deliver me from the college graduate." I by no means wish to deprecate the study of language and of philology. They are among the noblest that the student may undertake and well worthy of the ardent pursuit of the specialist. So, too, are the professions of law and medicine, but no one will presume to say that everybody should be a lawyer or a physician in order to be cultured.

At Yale College not less than nine or ten years of foreign language study are required for graduation, and not one week of any natural science. In the University of

Kansas, which may be taken as an average type of the Western universities, five years' study of foreign language must be had, and nothing whatever of any biological science.

Is that department of human knowledge which, more than all others, has been the foundation of the civilization of the present century; which has done more to lengthen life, to ameliorate its burdens, to improve, purify and advance the world; which has furnished one of the great underlying principles of modern education, of which even the philologist boasts—laboratory methods; which has established the great underlying principle of all progress—evolution; is this department of knowldge, I say, of so little importance that it is practically ignored in the requirements of a modern liberal education? Twenty-five years ago the classical course was the almost invariable one in our colleges; but even in those times I was required to learn the rudiments at least of physics, chemistry, botany, zoology and geology. Now modern education has liberalized the course by making the larger part of the language studies compulsory, and all, or nearly all, the natural sciences optional!

But the writing on the walls is so legible that he who runs may read. Yale College, the great exponent of the classical course, has been almost the only prominent college in the United States that has not gained materially in attendance during the past two years. Harvard, more liberal, does not insist upon so extended a study of the ancient languages, and will permit a considerable amount of science to be offered in their stead. Columbia College, which, until recently, has had requirements almost like those of Yale, has so modified its course that Greek is no longer demanded. To quote from its recent catalogue: "No one can obtain the degree of Bachelor of Arts who does not know something of at least one ancient language, and who has not therefore looked out through this window upon the world of antiquity. He must know also something of history, something of philosophy, something of political economy, a good deal of English, something of mathematics, and something of a least one natural science. He must also have a reading knowlege of French and German." It is refreshing to learn of one college that does require the student to leave that window of antiquity long enough to learn something of one natural science, of the laws that control the world and its inhabitants. We may be profoundly thankful that all the universities do not insist that we shall look out through two windows upon the high morality and civilization of the old Romans and Greeks.

In thus claiming some recognition for natural sciences in the course of liberal arts I shall doubtless be accused of narrowness. I trust, however, if I am, that it will not be imputed to ignorance of the classical course. I studied, when a youth, Latin and Greek for the prescribed time of six years each, and have since learned to speak or read three or four of the modern languages.

But I do more than claim recognition for the sciences. I claim broadly and emphatically that the natural sciences, any or all of them, are as valuable and as necessary as pure cultural studies as are the languages; that intelligent and successful study of them will do as much, if not more, in making the student a broad man, a successful man, as will the study of Latin or Greek. And they will do more in making him an honest man. Nowhere in all the broad field of knowledge will he learn better to think exactly than in the natural sciences. Nowhere will he be more impressed wih the importance of truth for truth's sake.

Among the graduates of the University of Kansas, with whom I am best ac-

quainted, there are not more than one-half who have had any training whatever in the natural sciences, with the exception of about ten weeks in physics and as many in chemistry, and perhaps a smattering of physiology. The simplest facts in natural history are as utterly unknown to them as is the prosody of the Hebrew language. A little, a very little, of biological science has been absorbed in the reading of fiction, of history and the newspapers.

The simplest functions of their own bodies remain for the most part sealed mysteries, the commonest laws of nature inscrutable. In fact, the ignorance of nature as a whole among the majority of the graduates of the so-called liberal colleges is usually abysmal in its profundity, stygian in its opacity. In the rules of philosophy they may be able to 'distinguish and divide a hair betwixt south and southwest side,' but are unable to tell the difference between granite and limestone, a polywog and a porpoise. In the laws of political economy they may talk learnedly and dogmatically, but are unable to locate the liver in their own body or to tell its functions. I verily believe that a third of the graduates in arts of our universities and a fourth of their instructors could not tell whether the pancreas is located above or below the diaphragm, or whether or not they have either pancreas or diaphragm at all. Grant Allen, in the *Cosmopolitan*, says: "Quite well-informed people will speak of a porpoise or a lobster as a fish; such grotesque blunders ought to be made impossible; they ought to be considered far more damnatory evidence of ignorance and ill-breeding than 'you was' or 'me and him went there.'" With such a standard how many college graduates are there who are educated?

President Dwight, in the same periodical, says: "In any future development of the college system the chief purpose of general culture should not give way or be subordinated to any purpose of special culture with a view of some special work in future years." It is this spirit of culture for culture's sake that has dominated Yale College so thoroughly in past years and which makes the institution to-day the best type of the non-utilitarian education in America. The same conservatism is evinced in Professor Peck's attitude toward education. The classical student with him is a 'gentleman and a scholar,' while the scientific student is a 'sublimated tinker.' No wonder that he urges the unwisdom of a higher education for the masses of the people.

There is much in favor of the primary importance of mind-building in education, and no education can be the best that makes it subordinate to the mere acquisition of knowledge. But the position is assumed, by those who favor the classical education, that utilitarian studies may not be at the same time cultural; that one may not get useful knowledge and mind-building at the same time.

To use President Andrews' words: "Our strictures upon classical studies in college would have less weight were it not that these subjects crowd from the curriculum numerous others which would at least be equally suitable for college drill and incomparably more valuable later. The common opinion seems to be that, to be useful in disciplining the mind, matter for study must be useless for the purposes of life. There could be no greater error. Studies like social, political, physical and biological science, and modern literature and history, all of which are vitally important for intelligent men and women who must live and act their part to-day, are precisely the ones best calculated to enlarge, cultivate and strengthen the intellect."

The mistake that President Dwight and those who think with him make is in assuming that all men are capable of the broadest and highest culture, or that a

liberal education should be limited to those only who have such capacities. We urge upon the future student of medicine that he should pursue a liberal classical course in preparation for his professional training. He replies that he has no aspirations and no ability to be a leader among men; he seeks only the best education he can get that will fit him for a more humble sphere. He skips the college course and devotes all his time to his professional studies. In fact, the strictly classical course, such as Yale best represents at the present day, is perfectly adapted for but one class of people, gentlemen of leisure, who are not dependent upon their daily toil for their bread. One would not ask the hod-carrier to pursue a course in the ancient languages before beginning his apprenticeship. Nor should one require the same of the ordinary professional student.

As an opposite extreme to the conservatism of Yale may be cited Leland Stanford University, in which knowledge of the ancient languages is not indispensable for graduation. In this institution twenty-two subjects may be offered for admission, only one of which (English) is required, the remainder to be chosen from the twenty-one other courses. This list includes algebra, geometry, trigonometry, physics, chemistry, physiology, botany, zoology, drawing, American, English and ancient history, Spanish, French, German, Latin and Greek. In the college course certain groups of studies must be selected under advice, but this is the only restriction upon free choice. The effect that this latitude has upon the choice of studies is interesting. Of those who last year took their major work in Latin and Greek there were 76; in history and economics, 219; in mathematics, 29; in the natural sciences, 223; in modern language, 80; in English, 140. In the ancient languages 151 students were enrolled the first semester of last year; in the modern languages, 686; in mathematics, 148; in the natural sciences, 926.

The friend of classical culture may justly say that the education that seems possible at Leland Stanford is a narrow and one-sided one. A student who knows nothing whatever of the foreign languages is as surely a dwarfed and one-sided man as is he who studies the languages only and none of the natural sciences. It is not to be supposed that the students of Leland Stanford are of a different class from the students of other universities. There their choice is almost wholly unrestricted and the natural inclination away from the ancient languages is conspicuously shown. The only bachelor degree given for work in any of the lines possible is that of Bachelor of Arts.

When the old classical idea was yet so firmly inwrought into higher education that all else was leather and prunella, degrees of all sorts sprung up as mushrooms—Bachelor of Science, of Philosophy, of Pedagogy, of Music, of Engineering, of Pharmacy, of Agriculture, of Mechanics, and of goodness knows what. They were frank statements that such degrees did not mean liberal culture and were given rather as placebos. These degrees have, fortunately, largely been abandoned, the older degree of Bachelor of Arts supplanting them; an acknowledgment that liberal culture may be obtained in other ways than the old classical one.

I am aware that many will lift up their hands in classical horror at the bare suggestion that such a thing is possible as a Bachelor of Arts course in science, thoroughly convinced that the wolf has at last stolen bodily the raiment of the sheep.

The effect of the present requirements for the admission to the colleges and university of Kansas has been in a high degree disastrous to science instruction in the secondary schools. Chemical laboratories

that once delighted and instructed the high school pupils, the microscope and its world of revelations, the herbarium, the museum and the dissecting knife, have been abandoned and in their place Latin, German and French have been substituted. Of all the subjects required for admission to the State University, students come best prepared in Latin, because the requirements in this subject have been made most severe and important. Instruction in the natural sciences in the secondary schools of our State is superficial and imperfect in the highest and most astounding degree. Of all those who are candidates for the State teacher's certificate to teach the sciences it is the exception that one has as much knowledge of any branch as might be acquired by the diligent student in ten weeks of work; rare that an examination paper is the equal of those offered by the second-rate students in our University.

Put, however, the same emphasis upon botany, zoology, chemistry and geology that is given to Latin and the preparation would very soon be fully as good, fully as thorough. Let the high school scholar learn that the study of the natural sciences is deemed as valuable in his preparatory training as is language or mathematics and there will be no lack of good teachers.

Were I, then, to say what the universities and colleges ought to do it would be this: Make all the ancient language requirements for admission optional, and demand as much preparation in the physical and biological sciences as in the foreign languages. The preparation in English should be made far more rigorous and thorough. In the college course, if anything besides English is required, and I think there should be, I would have the natural science as necessary a part of the education as language and mathematics. I would not have it possible for a student to graduate from the college without having studied, and thoroughly studied, mathematics as far as trigonometry, at least one foreign language, and at least one physical and one biological science. And I do not mean a few weeks of study in any of these branches, but exhaustive, careful, critical study.

The methods of study in all these branches are diverse and are absolutely essential for symmetrical mind-building.

Furthermore, an indefinite, haphazard selection of studies in the college course should be impossible. The course should be, so far as possible, adapted to the capacities, tastes and abilities of the individual, and this does not mean an indiscriminate selection on the part of the student. A person with feebly developed chest muscles might naturally prefer those physical exercises in which such muscles would take little part, but he nevertheless needs such exercise most.

It is through the great universities, and especially the State universities, that the solution of the problems of professional education must come, and in fact has come for some of the professions. With such cultural training as is best adapted to the lawyers's needs, the college course should include all the strictly non-professional branches, leaving the student, after he has completed his course as Bachelor of Arts in law, to take up the work of the professional school and complete it in two years with the degree of Doctor of Laws. In the medical course there are even greater opportunities than in law. The medical colleges should resign to the undergraduate arts course all the non-professional branches. And the work rightfully belongs there. The best chemical laboratories in the United States are not in the medical colleges, but in the universities. Nowhere are physiology, histology and anatomy better taught than outside of medical colleges. As in engineering, there should be an harmonious course leading through the high school to

the Bachelor of Arts in medicine, preparatory to two years of strictly professional work with the degree of Doctor of Medicine.

When such training as this is demanded of all aspirants to professional practice we shall have uniformly well educated men in the professions, and not until then.

S. W. Williston.

University of Kansas.

CURRENT NOTES ON PHYSIOGRAPHY.

THE REGION ABOUT LAKES TANGANYIKA AND NYASSA.

The origin by down-faulting of the linear depression holding Lake Tanganyika has been advocated by Suess in 'Das Antlitz der Erde,' and popularized by Gregory in his book on the 'Great Rift Valley.' An article by J. E. S. Moore on the Physiographical Features of the Nyasa and Tanganyika Districts (London Geogr. Journ., X., 1897, 289–300) gives additional notes of value. The south end of Tanganyika is enclosed on the west by a 2,000-foot sandstone escarpment, whence the plateau country slopes gradually westward to the shallow basin of Lake Bangweolo, whose waters are only ten or twelve feet deep; the plateau being broken by mountains of granite and gneiss which rise like islands above a sea. East of southern Tanganyika the country rises gradually; hence this part of the lake basin seems to lie in the depression between two tilted fault blocks, rather than in a *graben*. Passing southeast, the north end of Nyasa is found to lie between sandstone escarpments on either side, the enclosing uplands consisting of an uneven crystalline foundation whose depressions are occupied by sandstones and conglomerates like those around Tanganyika; this part of Nyassa is, therefore, regarded as a down-faulted rift. But going on to the south end of the lake and to its extension in Lake Shirwa, Moore finds nothing suggestive of great faults or rift valleys. Lofty granitic masses, with axes about north and south, enclose wide areas of waste slopes and alluvial flats, whose central depressions are occupied by malarial swamps and shallow lakes. The outflow by Shire river descends to lower plains through the Murchison cataracts.

It does not seem to be fully proved that the depressions between the granitic ranges were not produced by dislocations, although it is true that, in the absence of the heavy sandstones, faulting is not easily demonstrated. It may also be questioned whether the existence of the depressions 'now more or less completely filled up with decomposed granite and gneiss annually swept down into them from the hills by the prolonged tropical rain' prove that they 'have undoubtedly at one time been covered by water.' It may be added that the rains are not, properly speaking, 'tropical;' Dove having advisedly limited that term to the rains produced where the trade winds ascend mountainous slopes; the rains here are subequatorial, dependent not on the trade winds, but on the annual migration of the meteorological equator from the geographical equator.

BRÜCKNER'S ERDRINDE UND IHRE FORMEN.

The fifth edition of the standard Allgemeine Erdkunde, originally by Hann, Hochstetter and Pokorny, has for its second part a volume of 368 large pages on 'Die feste Erdrinde und ihre Formen,' by Professor E. Brückner, of Berne. It is a thorough and comprehensive work, but in its inclusion of Geology it illustrates how far Erdkunde departs from its supposed English equivalent, Geography. A quarter of the book is given to geology, including petrography, structure and stratigraphy half of the pages treat of the processes that determine surface form, and the remainder are devoted to the forms themselves. Internal processes produce volcanoes, earthquakes, shore changes and deformations.

External processes are grouped under ground water, weathering, sliding, rivers, glaciers, winds, waves and sedimentation. Forms are classified under those of the sea and of the lands; the latter being plains, escarpments, mountains, valleys, dissected regions (thallandschaften), basins, caverns, and the large forms of the land surface (mountains, plateaus, depressions). The terse style of the book shows that its author expects those who use it to be competent teachers and faithful students. Its readers may be confident of trustworthy statements and explanations; but in the third part, with which these notes are particularly concerned, there is less consideration of the genetic correlation of parts than would be welcomed by many.

THE AGE OF VALLEYS.

THE age of a valley is a measure of its stage of development. It may be steep sided and young; it may half open or mature; it may be wide open or old. At any stage in its development it may be submerged and buried, and thus preserved until some future time when it is again revealed by weathering, like any other fossil. In this sense the valley, whether young or old, may be dated as geologically ancient or modern. Thus there were mature valleys in ancient times among the St. Francis mountains of crystalline rocks in southeastern Missouri. They are still hardly more than mature, for through nearly all Paleozoic, Mesozoic and Cenozoic time they have been buried; they have only in comparatively recent time come to light again, as their relatively weak sedimentary cover has weathered off. But in another sense these mature valleys are modern, for they have been re-excavated in late post-Tertiary time. When the ancient and modern valleys coincide there may be confusion if they are briefly described as 'of very ancient origin,' and this confusion appears to enter in the paragraph given to the deep canyons of Labrador, in Adams' review of Low's report in a recent number of SCIENCE (Nov. 13, 741). The implication here, as in the original report, is that the valleys have been valleys ever since the time of their ancient origin. The probability is very great that during most of the intervening time they have been buried, and that however ancient was their initial excavation their present re-excavation is relatively modern.

W. M. DAVIS.

HARVARD UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

THE QUESTION OF VARIATION.

Two recent essays on variation as applied to man may be mentioned together, although they treat the subject from different points of view. The one is by Professor Virchow, in the Proceedings of the Berlin Academy of Sciences for 1896. He describes the difference between diathesis, *Anlage* and variation, the former being the permanent, the latter the changing factor of the organism. He points out the important fact that progressive variation may arise from pathological inceptions. While his article has the greater bearing on questions of medical science, it has valuable application in anthropology.

The second article is by Professor Mahoudeau in the *Revue* of the Paris School of Anthropology for July of this year. It is taken up principally with pointing out the exact meaning of variation or transformation in organic life as laid down by Lamarck. The quotations show that he distinctly taught the descent of man from lower forms of life. In these respects he is claimed to have anticipated the most modern doctrines in his celebrated work, first published three quarters of a century ago.

THE CITY OF OMITLAN.

A year or so ago the newspapers mentioned the discovery of a ruined city in western Mexico by Mr. William Nivens. Since then collections have been brought to New York City, and ample means thus furnished to judge of its characteristics. In the *Bulletin* of the American Geographical Society for July of this year, Mr. Nivens has a short article on the subject. The ruins are very extensive and indicate a skill in stone work above that of many tribes, but decidedly inferior to that of the best Aztec civilzation. His article speaks of a tablet with hieroglyphic characters, but examples of such are extremely rare, and perhaps of doubtful origin. The stones are, as a rule, not dressed with skill and the structures were not lofty. From all this we may conclude that we have in these extensive remains the relics of an inferior, subordinate culture-center of Aztec civilization; but this, of course, does not in any way diminish the interest which attaches to Mr. Nivens' explorations.

THE CAVE OF LOLTUN.

Loltun is the name of a remarkable cavern in Yucatan. The Peabody Museum of Archæology has just published a report of its exploration by Mr. Edward H. Thompson, in 1890–91. It is unfortunate for Mr. Thompson that the Museum waited six years to print his interesting account, as in the meanwhile another expedition, led by Mr. H. C. Mercer, of the University of Pennsylvania, carefully explored and promptly printed a full description of it in 1896. Boards of publication should be aware that the world gives credit not to him who first investigates, but to him whose investigations are first placed for use before students.

The report is well printed with attractive illustrations. The excavations were carefully made and confirm the opinion advanced by the later expedition that those who entered or dwelt in the cave belonged to the same race and people, and possessed the same culture, as those who built the great stone structures on the surface near them. Neither here nor elsewhere in the Yucatan caves did Mr. Thompson discover any signs of a distinctively 'cave people,' or of an earlier, ruder civilzation.

D. G. Brinton.

University of Pennsylvania.

NOTES ON INORGANIC CHEMISTRY.

To Berthelot's researches we owe very much of our knowledge of the chemistry and technology of the ancients. In the last *Comptes Rendus* he recounts his examination of glass mirrors found near Reims, dating from the third and fourth centuries. The glass was coated with a metal and also a whitish layer. The metal proved to be lead, with no trace of gold, silver, copper, tin, antimony or mercury, nor was there any organic substance present, showing that no extraneous material was used to cement the lead to the glass. The mirrors appeared to have been cut from hollow blown glass globes, and it is probable that, before being cut, the molten lead had been poured into the interior, adhering to the previously warmed glass. The whitish layer consisted of lead carbonate and lead oxid formed by the oxidation of the lead coating, and calcium carbonate, which had been deposited from the water of the vicinity. A similar method of coating glass with lead was known in the thirteenth century. In the same find were fragments of glass showing the lustre of gold and of silver; these metals were not present, but the color was due partly to the lamellation of the glass and partly to a very thin layer of calcium carbonate which had been deposited on them.

In the *Chemiker Zeitung* Léon Franck describes experiments with the every-day use of spoons, forks and vessels of aluminum.

The metal was 99 per cent. pure, containing varying quantities of iron and silicon. A boiler of 732 sq. cm. surface lost in three years' daily use 0.1046 gram, a daily loss of 0.09 milligrams. Another boiler of the same size in which milk was boiled twice a day for fifteen minutes lost in three years 0.5138 gram. An impervious coating seemed to be formed on the metal which protected it from further action. This was shown by experiments with sheet aluminum, which was boiled daily three hours with water, and which suffered greater loss near the beginning of the experiment than at its close. Forks and spoons lost very little by constant use at meals, and the same was true when used for salads, and also when used in cooking. After three years' constant use coffee spoons showed a loss of from 0.032 to 0.036 grams and tea spoons from 0.0206 to 0.0244 grams. These experiments would tend to show that for ordinary table purposes aluminum is a safe metal to use, and that it is also safe for vessels for boiling water. A similar series of experiments where salted foods and vegetables were cooked in aluminum vessels would be interesting and valuable.

IN the *Zeitung für Beleuchtungswesen* Paul Wolff discusses the question of acetylene generators. Most generators depend upon the removal of the water from the calcium carbid by the pressure of the gas to stop the action of the generator. The author shows that this is not sufficient. There are three causes for the action of the water on the carbid not ceasing. 1. The gas in the carbid chamber is saturated with water vapor, and the water is continually evaporating into this chamber. 2. A part of the water is taken up by the warmed lime and given off on cooling. 3. The carbid above the water is continually absorbing water. These difficulties may be obviated to some extent by providing that the water chamber be separated as completely as possible from the carbid chamber, as in a Kipp apparatus, but even then the action will go on until all the water present, as vapor in chamber and absorbed by the lime, has been exhausted. It is thus imperative to provide a gas reservoir large enough to contain all the gas which may, under these circumstances, be evolved after the gas has been turned off. The author in the article discusses the necessary size of this reservoir for different generators.

J. L. H.

SCIENTIFIC NOTES AND NEWS.

THE will of the late Dr. George H. Horn gives his valuable entomological collections, together with his entomological books and instruments and an endowment of $200 per annum, to the American Entomological Society. From the residuary estate, after the death of his sister, the Entomological Society is to receive $5,000, the Philadelphia Academy of Natural Sciences $1,000 and the American Philosophical Society $500.

LATE advices from the Pribilof Islands state that many yearling fur seals branded as pups in 1896 made their appearance on the hauling grounds in September and October; also that over 5,000 pups and 180 adult females were branded this year. Apart from the practical bearing of this work it will furnish definite evidence of the movements of the seals and show to what extent the females resort to the rookeries on which they were born or on which they first appeared as two-year-olds.

MR. CHARLES WALLACE HUNT, New York, has been elected President of the American Society of Mechanical Engineers.

PROFESSOR JACOB REIGHARD, of the zoological department of the University of Michigan, has been appointed by Governor Pingree a State delegate to the National Fishery Congress to be held at Tampa, Fla., January 19, 1898.

FURTHER jubilee medals have been conferred upon Dr. Günther, President of the Linnean Society; on Professor Dewar, President of the Chemical Society, and on Professor R. Meldola, late President of the Entomological Society.

PROFESSORS O. HERTWIG, F. E. Schultz, Berlin, and A. Fick, Wurzburg, have been elected corresponding members of the Munich Academy of Sciences.

WE learn from *Nature* that Professor A. Bauer has been obliged, on account of ill-health, to decline the office of President of the third International Congress for Applied Chemistry, which is to be held next year at Vienna, and Dr. H. R. von Perger has been elected in his stead. There will be twelve sections in connection with the Congress. Among the subjects to be discussed is the introduction of uniform methods of analysis of chemical products.

ALONZO S. KIMBALL, since 1872 professor of physics at Worcester Polytechnic Institute, died at Worcester on December 2d, aged fifty-four years.

THE death is announced of Dr. Louis Calori, elected as long ago as 1830 professor of anatomy in the University of Bologna. He made important contributions to human and comparative anatomy, including extensive researches on the Reptilia.

DR. M. FORSTER HEDDLE, best known of British mineralogists, died at St. Andrews on November 19th, aged sixty-nine years.

WE also regret to record the deaths of Dr. Wilhelm Blomstrand, professor of chemistry in the University at Lund; Dr. Nikolaus Kleinenberg, professor of comparative anatomy at the University of Palermo; Dr. Wilhelm Moericke, docent in geology in the University of Freiburg.

MR. J. G. SUDBOROUGH, University College, Nottingham, writes to *Nature* calling a meeting of the British students of the late Victor Meyer, in order to raise a memorial to him, to be erected in the Heidelberg lecture theater. His former students in America would doubtless be glad to join in such a memorial.

THE American Institute of Homeopathy has been successful in collecting funds for a monument to Hahnemann. It is said that as much as $75,000 has been collected and that the bronze statue by Mr. C. H. Niehaus will be dedicated during the spring at Washington.

THE New York Board of Estimate and Apportionment adopted unanimously the plan for the New York Public Library prepared by Carrère & Hastings.

BY the will of the late Warren G. Roby, of Wayland, Mass., the sum of $28,000 and half an acre of land has been left to the town of Wayland for a public library.

THE National Museum of Santiago, Chili, has purchased, at a cost of about $7,000, the valuable collection of Peruvian antiquities made by Mr. Nicolaus Saenz.

THE centenary of the Natural History Society of Hannover will be celebrated on December 15th and the two following days.

Nature states that M. Moureaux has just completed the installation of the new magnetic department of the Parc St. Maur Observatory, and it was set in operation on December 1st. The work at the old magnetic rooms will be continued until January 1st, in order to supply M. Moureaux with a sufficient number of observations for a reduction of the valuable records obtained continuously during a number of years.

A PASTEUR INSTITUTE has been established at the University of Montpellier.

THE Romanes Lecture at Oxford University next year will be given by Sir Archibald Geikie.

DR. G. F. JACKSON opened the winter course of lectures at the Imperial Institute on November 19th, the Prince of Wales presiding, with an account of the results of the Jackson-Harmsworth Expedition, on November 22d. Mr. E. S. Bruce lectured on 'Electric-Balloon Signaling applied to Scientific Exploration in Arctic and Antarctic Expeditions.' Other lectures announced for the course are illustrated lectures on 'The Wild Kafirs of the Hindu Kush,' by Sir George Scott Robertson, and on 'The Mineral Resources of British Columbia and the Yukon,' by Mr. A. J. M'Millan, of Rossland, British Columbia, formerly British agent for the government of Manitoba, who has been specially supplied with specimens, etc., to illustrate the lecture by the government of British Columbia. Professor W. C. Roberts-Austen, C.B., F.R.S., will lecture on 'Canada's Metals,' and Mr. Boverton Redwood on 'The Petroleum Sources of the British Empire.'

ARRANGEMENTS have been made for lectures by Professor Shaler and Professor James, of Harvard University, before the Teachers' College, New York.

DR. FRANZ BOAS, of Columbia University, lectured on December 3rd at the Peabody Museum, under the auspices of the Harvard Folk-Lore Club, his subject being 'The Growth of Indian Mythologies in British America.'

SURGEON-GENERAL GEORGE M. STERNBERG addressed a recent meeting of the Pittsburg Academy of Medicine on the 'Relations of man and microbe.'

DR. SVEN HEDIN, to whose travels in Central Asia we have several times referred, gave an account of these before the Royal Geographical Society, London, on November 22d.

A LETTER from Mr. Charles M. Harris, who is now at the head of the Rothschilds expedition to the Galapagos Archipelago, has been received by his brother, Dr. W. H. Harris, of Augusta, Me. Mr. Harris sailed from New York for Panama on March 20th, where he expected to charter a schooner, but three of the party there died from yellow fever. Mr. Harris then proceeded to San Francisco, where he reorganized the party and reached the islands after a passage of forty days. He states that he has been successful in making extensive collections of the fauna and flora of the islands, and expects to return to San Francisco in the spring.

THE Washington correspondent of the New York *Tribune* states that Dr. Henry S. Pritchett assumed charge of the United States Coast and Geodetic Survey on December 1st. The dispatch continues: "It will be highly gratifying to scientific circles and the friends of this Bureau to learn that the President and Secretary Gage are determined that the Bureau shall be conducted on scientific and business principles and that their plans will be carried out. Dr. Pritchett was selected entirely on the recommendations of scientific men, regardless of political views. * * * * He is a worthy successor of Dr. T. C. Mendenhall, whose admirable administration of the Bureau from 1889 to 1894 is so well remembered."

IN addition to volumes of the Contemporary Science Series (Mr. Walter Scott, London; imported by Messrs. Charles Scribner's Sons, New York) requiring special notice we have received two volumes—one a translation and one a new edition, to which attention may be called. Professor Ribot's '*Psychologie des sentiments*,' of which we gave a detailed review at the time of its publication, has been translated into English, thus much enlarging the audience of the acknowledged leader of French psychology. Dr. Moll's '*Hypnotism*' has been issued in a fourth edition, being apparently more in demand than any other volume of the series. We have not the third edition at hand for comparison, but the book has been much altered and enlarged since the publication of the first edition in 1889. The popular interest in hypnotism is in part morbid, and the numerous and widely circulated books, journals and articles on the subject do not usually add much to its scientific study, while they in some cases promote credulity and amateur experimenting. Dr. Moll's book, however, is sane and scientific, and it is to be hoped that some who come for a 'sensation' may go away with an increased knowledge of mental phenomena.

UNDER the title 'An Unusual Phyto-bezoar,' Professor Trelease has published, in the Transactions of the Academy of Science of St. Louis, an account of certain balls, composed of the felted barbed trichomes of *Opuntia*, obtained from the stomach of a Mexican bull, and comparable with similar formations described in 1896 by Dr. Coville as occurring in the stomach of a horse, and composed of the calyx hairs of a species of *Trifolium*.

THE fourth and revised edition of Professor Thurston's Engine and Boiler Trials has just been issued. In the front of the book the publishers print a descriptive list of nineteen of Dr. Thurston's works.

THE explosives department of the British Home Office has, as we learn from *Machinery*, recently had under consideration the question of the restrictions to be applied to the manufacture and keeping of acetylene gas, and has conducted various experiments with the object of gaining information on this matter. The results show conclusively that acetylene gas *per se*,

when under a pressure of something less than two atmospheres, is violently explosive; whereas, at a pressure of less than one and a half atmospheres, it appears to be reasonably free from liability to explosion, provided it is not admixed with oxygen or atmospheric air. For commercial and practical purposes it is considered sufficient to allow a pressure of twenty inches of water above that of the atmosphere (*i.e.*, roughly about one and one-twentieth atmospheres), and it is accordingly proposed to draw the safety line at this point, and to declare acetylene, when subject to a higher pressure, to be an 'explosive' within the meaning of the Explosive Act of 1875. In France and Germany the authoritities have fixed the limit of danger at one and a-half and one and one-tenth atmospheres respectively, and have imposed prohibitions or restrictions on the keeping or the manufacture of the gas when it is at a higher pressure.

Two notable articles in the *Revue de Mécanique* for October are those of Dwelshauvers-Dery on the effect of compression of steam in the 'dead spaces' of steam engines, and Sinigaglia on the employment of superheating as a source of gain in thermodynamic and actual efficiency. The former finds by trial with the 'experimental steam engines' of the University of Liège that increasing compression results in increasing waste and decreasing efficiency, the loss of power in the engine more than counterbalancing the 'initial' condensation in the steam cylinders. The latter describes in the third of a series of papers the various types of superheating apparatus employed, and gives results of their use, the gain being sometimes 20 % and more.

At the Sydney meeting of the Australasian Association for the Advancement of Science, to be held in the second week in January, Sir James Hector, F.R.S., will give a popular lecture on 'Antarctica and the Islands of the far South,' and Professor R. Threlfall and Mr. J. Pocock will give a lecture to workingmen on 'Electric Signaling without Wires.' The Sydney *Morning Herald* states that the Australasian Association originated in a letter from Professor Liversidge published in that journal in 1884. The first meeting of the Association was held in Sydney from August 27th to September 5th of the Centennial year, 1888, under the presidency of Mr. H. C. Russell, F.R.S., when 850 members were enrolled. Meetings have also been held at Melbourne, with 1,162 members, in 1890, when the late Baron von Mueller, F.R.S., was President; at Christchurch, New Zealand, with 550 members, in 1891, President Sir James Hector. F.R.S.; at Hobart, with 600 members, in 1892, President Sir Robert G. C. Hamilton; at Adelaide, with 488 members, in 1893, President Professor Ralph Tate, F.G.S.; and at Brisbane, with 524 members, in 1895, when the Hon. A. C. Gregory was President. The governments of Victoria, Tasmania, New Zealand, South Australia and Queensland have each in turn given assistance to the extent of about £1,200, either wholly or in part, as a money grant towards the expenses of the session and publication of the annual volume.

UNIVERSITY AND EDUCATIONAL NEWS.

Mr. Dean Sage and Mr. William D. Sage have given to Cornell University the house of the late Henry W. Sage for a University Infirmary. They also endow the institution with $100,000 and will equip the building for a hospital, the total value of the gift being $200,000.

The will of the late Sir Thomas Elder, of Adelaide, South Australia, leaves large sums to charitable and public institutions of Adelaide, including the following: To the Zoological Society, £2,000; to the Geographical Society, £2,-000; to Way College, £2,000; to Prince Alfred College, £4,000; to the Picture Gallery, £25,-000; for a chair of music at the University, £20,000; to the Medical School of the University, £20,000, and to the University £25,000.

Mr. Andrew Carnegie has given $10,000 to the endowment of the Mechanics' Institute in Richmond, Va.

The late Sir William Mackinnon has left a legacy of £2,000 to the University of Glasgow for a scholarship, in the following subjects: (1) Geology; (2) Natural History, together with Comparative Anatomy; (3) Modern Foreign Languages; the examination in each subject to be taken in each succeeding year in rotation.

KING'S COLLEGE, London, has received an anonymous gift of £25,000 towards the liquidation of its debt.

MR. JOHN P. ASHLEY, PH.D., has been elected President of Albion College, at Albion, Mich., succeeding Dr. Lewis R. Fiske, who has resigned, owing to advanced age, after twenty years of service.

DR. E. G. LANCASTER has been appointed professor of psychology and pedagogy at Colorado College.

A CHAIR of 'tropical diseases,' with Dr. J. E. Stubbert as the first incumbent, has been established in the New York University Medical College.

A COMMITTEE has been formed in London to present a plan for a London University, to be called University of Westminster, in case the bill before Parliament meets with continued opposition. The present degree-conferring University of London would according to the plan remain unchanged, while the different institutions of London would form themselves into a faculty of law, a faculty of medicine, etc., each institution to be financially independent and only to agree on the nature and duration of the studies required for degrees and distinctions.

DISCUSSION AND CORRESPONDENCE.

IN REGARD TO THE MARINE BIOLOGICAL LABORATORY AT WOODS HOLL, MASS.

TO THE EDITOR OF SCIENCE.—A full and adequate rejoinder to the statement which appeared in SCIENCE October 8, 1897, has been prepared and is now ready. In our opinion, however, controversial matters relating to the management of a scientific institution, especially when consisting of details, statistics or mooted points, are out of place in public prints. The subject is not of general interest, and discussion of this kind tends to injure any institution in the public estimation.

The undersigned, therefore, prefer to reply only to those concerned in the matter. To this end we shall issue to all members of the corporation and others concerned a detailed reply to the charges brought by the former Trustees. Others who may feel interested can obtain copies by applying to the Secretary of the Trustees of the Marine Biological Laboratory, Woods Holl, Mass., or to either of the undersigned.

SAMUEL F. CLARKE,
EDW. G. GARDINER,
J. PLAYFAIR MCMURRICH.

SCIENTIFIC LITERATURE.

Anthropologische Studien ueber die Ureinwohner Brasiliens. Von DR. PAUL EHRENREICH. Braunschweig, Vieweg und Sohn. 1897. 4to. Pp. 168. 30 Plates.

This work ranks among the most valuable which have appeared for years in American Anthropology. It is, to be sure, somewhat limited in its area of observation, being principally confined to the states of Matto Grosso, Goyaz and Amazonas in Brazil; but this is more than compensated by the abundance and accuracy of the material, and the skill with which the author has brought it into bearing on the leading general questions relating to the American race.

These are treated in the general portion of the volume, occupying forty-five pages. It embraces two chapters, one on the aims and methods of physical anthropology and its bearings on ethnology; the other specifically on the anthropologic position of the American race. Much of the former is concerned with defining such terms as race, type, people, stem, family, etc.; with the conclusion that race means blood relationship, and that the racial characteristics and variations are the only real objects of study in physical anthropology. The author is here on thin ice, and his definitions, carefully trimmed as they are, can often be punctured. Blood relationship, *Blutverwandtschaft,* really means nothing, for, in one sense, the whole human species is related by blood; and as much might be said of other terms assumed to have a generally recognized sense. This merely shows how needful it is to settle on an international terminology in anthropology.

The chapter on the Amercan race is more satisfactory. He regards it as strictly one, in the Blumenbachian sense. As for the question, Whence it came? He regards it superfluous to inquire, as it has certainly been on the continent from remotest human antiquity, probably

under widely different geological relations, and before language had developed. He considers the following three propositions 'established beyond question:' 1. Man is as old in America as in Europe. 2. The oldest American skulls present the same type as those of the modern Indians. 3. Between the languages of America and Asia there is a gulf which cannot be bridged. (P. 42.)

The special portion of the book is divided into two parts, the one supplying the measurements on the living subjects, the other those on skulls and skeletons. Numerous illustrations from photographs, detailed tables and outlines of skull-forms greatly aid the student in obtaining clear ideas of the physical characters of the tribes mentioned. They include the Caribs, Bakairi, Tupis, Botocudos, Chaco tribes, and those of the valley of the Purus River.

The general conclusion which he draws from these extensive comparisons will be surprising to many, especially those who have said so much about the 'Mongoloid' traits of the American Indians. "So far as their physical traits are concerned, these Indians of ours approach much more closely the types of the Caucasian than of the Mongolian race. The arms and generally the upper extremities, the elevation of the symphysis and the navel, are thoroughly European." (P. 130.)

The osteological material was mainly from the Bororo, Karaya and Kayapo tribes. It is figured fully and the measurements presented in detail. Some of the skulls were of low capacity and their nannocephalic character suggests the already known relations of the people of the Purus, among whom they prominently occur, to the Arawacks of the northern shores of the continent, and to the island-dwellers of the West Indian archipelago.

The general impression left after an examinations of the craniological measurements, however, is one of wide diversity, a diversity not satisfactorily explained by the author's various suggestions of amalgamation and environment, but from its sporadic abundance, going back to sources of variation in skull-proportions which diminish their value as race criteria.

The work is furnished with a table of contents, an index of authors quoted, and one of subjects; a completeness of reference which it is a pleasure to note.

D. G. BRINTON.

The present volume is of great importance, not only on account of the detailed information given in the special part of the work, but also on account of a critical examination of the methods of somatology. The following lines are intended as a review of this general part of the work.

Dr. Ehrenreich is one of the few anthropologists who have an equal command of somatological, ethnological and linguistic methods. His criticism of modern somatology is directed mainly against the excessive weight given to measurements as compared to morphological description and to the loose use of the terms race and type.

He would reserve the term 'race' for the principal divisions of mankind, while he would call the varieties of these main divisions 'types.' He objects strongly to the application of the term 'race' to closely affiliated varieties which differ in regard to a few measurements, while their fundamental morphological features are much alike. He justly attributes much of the confusion prevailing in anthropological literature to a lack of clear distinction between the main groups and their subdivisions, and particularly to the tendency which has developed of recent years to consider a few anthropometrical criteria as a sufficient basis for the establishment of a new race.

In determining the 'races,' or the main divisions of mankind, Ehrenreich demands the consideration of three principal phenomena. He claims that each race is characterized by similarity of anatomical traits, geographical continuity of habitat, and similarity of the structure of the languages spoken by the people constituting the race. The first two points are well taken. They refer, of course, to conditions prevailing before the modern migrations of races. I doubt, however, if it is admissible to introduce the last point of view in the definition of the principal divisions of mankind. Ehrenreich is led to include languages in the characterization of races by three considerations. He says: (1) Every race has developed a greater or lesser number of characteristic linguistic stocks. (2) These stocks are not found outside

the limits of each race, excepting a few instances which are explained by certain peculiar conditions. (3) There are fundamental differences between the structures of the languages spoken by the different races, and no connecting links between them exist. Based on these arguments he distinguishes six races, leaving the position of the Papuas and of the black peoples of Asia doubtful. I will not lay great stress upon the fact that these principles of classification lose their applicability among the last-named people, as in their case peculiar conditions prevail. But there are other cases which show that these principles do not help us to establish a definite number of races. The linguistic considerations would make it impossible to include the pre-Aryan peoples of Europe and western Asia, in what Ehrenreich terms the Caucasian or Mediterranean race, although the anatomical characteristics of these peoples are identical with those of the Mediterranean race. On the other hand, the American race shows considerable anatomical uniformity as compared to other races, and, nevertheless, there is no unity of structure of language in Ehrenreich's sense of the word. It is no less possible to imagine a connecting link between the principles of structure of the Algonquin and Eskimo than between the Eskimo and Ural-Altaic languages. If we are willing to consider American languages as a unit, and include only these principles in the general characterization of American languages that hold good in all of them, there is nothing to prevent us from including Ural-Altaic languages in the same group. Ehrenreich agrees in these opinions with the views expressed by Brinton in his discussion of the characteristics of American Languages. (Essays of an Americanist, p. 350 ff.)

Dr. Ehrenreich's second criticism of modern anthropology is directed against the excessive weight given to measurements as compared to morphological descriptions. He expresses the opinion that the classification according to cephalic indices which has held sway since the days of Retzius has greatly hampered the development of somatology and has made efforts at classification futile, since these were based on measurements, particularly on indices, alone, while they must be based on morphological descriptions. These latter, he holds, cannot be replaced by numerical values. While heartily agreeing with this view, particularly with the objection to the exaggerated value given to the length-breadth index of the head, I do not think that Dr. Ehrenreich's condemnation of anthropometry is quite justified. He defines the object of somatology as the somatic investigation, description, and if possible explanation of racial characteristics. With this, I believe, all anthropologists will agree. The only question is what methods are best adapted to these ends. A broad view of the history of anthropology shows that measurements were originally introduced in order to give precision to certain descriptive features which could not be expressed satisfactorily in words. This appears to have been the leading view of Daubenton and Camper, who were the first to introduce measurements in discussions referring to comparative anatomy. The nearer alike the types which we compare, the more difficult it is to describe in words their nice distinctions. Anthropology was the first branch of descriptive biology to deal with closely allied varieties, and for this reason the need of substituting exact numerical values for vague descriptions was soonest felt. Since zoology, more particularly the study of mammals and of birds, has begun to take into consideration the geographical races of the same species we observe the same tendency of adding measurements to verbal descriptions.

In so far as Dr. Ehrenreich's criticism is directed against the substitution of measurements for descriptions that they should supplement, it is most timely and ought to be taken to heart by investigators. The terms dolichocephalic and brachycephalic as indicating two groups of head forms determined by measurements have by some investigators been raised almost to the rank of specific characters, although, as Ehrenreich justly emphasizes, and in this he has the support of Sergi, Harrison Allen and others, the sameness of the index does not by any means signify sameness of morphological type. He disclaims the significance of these characters when not supported by general morphological agreement. In all this the author is certainly right. But he overlooks entirely the principal and fundamental value of numerical measures

as illustrating the range of variability of types which cannot be given by any verbal descriptions. The type inhabiting a certain region cannot be defined satisfactorily by a substitution of descriptive features selected by even the closest observation. It is not possible, as Ehrenreich says, to represent a type by a typical individual. The description must include all the individuals in order to illustrate the composition of the group that is being studied. In order to give an adequate description it is necessary to illustrate the frequency of different types composing the group. While the types found in two adjoining areas may be almost identical their distribution may differ. The attempts to treat the same subject by means of composite photographs or composite drawings, which form a purely theoretical point seem very promising, offer serious practical difficulties which make it difficult to use these methods. The variability of a type can, therefore, be expressed only by means of carefully selected measurements. Dr. Ehrenreich states with great clearness that none of the proposed series of measurements are satisfactory, but we must add that a way exists of discovering such measurements. This way is shown in Professor Karl Pearson's admirable investigation on correlations which was suggested by Galton's important work on heredity. By its means laws of correlation may be discovered which express morphological laws. It seems to me, therefore, that the author's condemnation of anthropometrical methods for determining geographical varieties is too sweeping.

The scepticism with which the author regards the results of anthropometry lead him also to the conclusion that sameness of type is not a sufficient proof of common descent; that the latter is only proved if supported by historical and linguistic evidence. This opinion is open to serious objections. It is certainly true that it is impossible to determine by anatomical characteristics alone to what people a single individual belongs. But it is perfectly feasible to identify a series of individuals belonging to a certain people or district, if the series is sufficiently large. Dr. Ehrenreich, it would seem, has been misled by the fact that all types are variable and cannot be represented by a single typical individual to consider the whole task a hopeless one. Even though it is not possible to establish for a people a single anatomical type to which all individuals conform and which is characteristic of that people and no other, this does not prove that we cannot trace its genesis by means of a study of the various types constituting the people and their distribution among the people itself and its neighbors. The author acknowledges this fact to a certain extent when saying: "Whoever tries to rely in these investigations on physical characters alone will certainly be led astray. A consideration of the geographical point of view and of historical evidence will give much greater certainty to his conclusions." Here, as in the discussion of the races of man, the author strongly emphasizes the geographical point of view, and in this he agrees with F. Ratzel. He urges the necessity of considering the geographical probability of blood-relationship before generalizing from anatomical similarities. The considerations of this point of view, on which the reviewer has also repeatedly insisted, will certainly prevent anthropologists from forming rash conclusions and propounding extravagant theories.

But I do not believe that the introduction of linguistic considerations in the somatological problem will be found to be of advantage. It is true that wherever we find two tribes speaking affiliated languages there must have existed blood-relationship; but we have abundant proof showing that by infusion of foreign blood the anatomical types have changed to such an extent that the original type has been practically swamped by the intruders. Such is the case in North America among the Athapaskan tribes of the Southwest, among the widely scattered Shoshonean tribes, and in many other cases. The laws according to which anatomical types are preserved are not the same as those according to which languages are preserved, and for this reason we must not expect to find the results of classifications based on these two considerations to coincide. Dr. Ehrenreich seems to think that types are too variable to give any satisfactory basis for deductions of this character. But, notwithstanding the fact that certain anatomical features are easily

affected by the influence of environment, I cannot acknowledge that any proof of the transformation of the fundamental features of types exists.

In our investigations on the early history of mankind three methods are available, each directed to a certain series of phenomena—physical type, language, customs. These are not transmitted and do not develop in the same manner. The one persists when the other changes, but all may be made to contribute to the solution of the general problem. The study of the distribution of languages permits us to make nicer divisions and to follow historical changes in greater detail than that of the distribution of physical types. But often the latter give evidence in regard to phenomena which cannot be approached by linguistic methods. The distribution of the Alpine type of man in Europe, or that of the Sonoran type in North America, may be mentioned as instances of this kind. It would be absurd to state that in these cases similarity of type does not prove blood-relationship, because there is no linguistic evidence to support it. On the contrary, the physical investigation supplies evidence that cannot be gained by linguistic facts. The three methods mentioned above are all equally valuable, but since they do not refer to the same classes of facts it must not be expected that they will clear up the same incidents in the early history of mankind, but all may be utilized with equal advantage in the study of this subject.

In regard to the affinities of the American race to other races Dr. Ehrenreich seems to be inclined to consider it as equally closely related to the Asiatic and to the European races. He lays particular stress upon the proportions of the body and the form of the hair as distinguishing the Americans from the Asiatics. In this opinion he agrees to a certain extent with Brinton. It would seem to me that in determining the position of a race we should be guided by the morphology of its most generalized forms, namely of women and children. The far-reaching similarity between American and Asiatic children and women is very striking. They have in common the wide and rather low nose, the form of the eye and of the maxilla. The physiognomic similarity is so great that it would seem to be of greater weight than the variable proportions of the body which are much more subject to influences of environment.

FRANZ BOAS.

The Alternating-Current Circuit: An Introductory and Non-mathematical Book for Beginners and Students. By W. PERREN MAYCOCK. London, Whittaker & Co. 1897. 16mo. Pp. 97. Price, $1.00.

It is the author's purpose to convey some idea of single-phase alternating currents to the minds of those new to the subject, by means of plainly worded and non-mathematical language. In his preface (April, 1897) he states that the book forms the substance of a chapter in the forthcoming Volume II. of 'Electrical Lighting and Power Distribution.' With a thorough revision it would make an admirable chapter for such a book. Although the book is small, the reviewer appreciates the amount of labor that has been spent upon it in arranging the more important alternating current phenomena and discussing them in a manner suitable for non-mathematical beginners. The author has attempted to make his style simple and clear, successfully in the main, but with many startling lapses. What idea is conveyed to a reader (and he need not be a non-mathematical beginner) from the statement (p. 8), "The current in a given circuit is thus proportional to the distance traversed at each alternation by any given coulomb, *C*, multiplied by the number of alternations per second; so that if the current is kept constant, when the frequency is doubled, the path traversed by any given coulomb will be halved, and *vice versa*."

We note error as well as confusion; for example, on page 64 we are told that reactance varies directly as the inductance and the mutual induction. As a matter of fact, mutual induction in a case of a transformer diminishes the reactance; for the primary circuit of a transformer has less reactance when the secondary is loaded than when it is on open circuit. Again, it is stated (pages 64 and 85) that reactance depends directly upon the inductance and the *frequency*, and inversely upon the capacity. This is true when the current lags behind the

electromotive force, but when the circuit is in advance of the electromotive force an increase of frequency decreases the reactance.

The author points out that the terms virtual and effective are employed indiscriminately by some writers, but has been unsuccessful in his attempt to make the terms clear. The effective value of the E. M. F. is taken to be its component of direction of the current; the effective current is the component of current in the direction of the E. M. F., all of which is quite beyond criticism, unless it be one of words. 'Virtual value' is adopted to designate the square root of the mean square value and is properly explained to be the equivalent of a direct electromotive force or current which would produce the same effect either on an electrostatic voltmeter, or in heating. Thus, we may have occasion to refer to the virtual value or to the maximum value of any quantity, as of the impressed E. M. F., of the effective E. M. F., of the total current, or of the effective current. Although thus clearly giving a proper meaning to the term virtual, the author usually employs 'virtual E. M. F.' as synonymous with 'impressed E. M. F.,' and 'virtual current' as being the total or actual current which flows as distinguished from a particular component of it. Thus (p. 83), "In most circuits the impressed or virtual E. M. F. meets with an opposing E. M. F. of reactance, and the effective E. M. F. is something less than the virtual E. M. F. * * *" Also (p. 84), "That proportion of the current which can do useful work may be called the *effective current.* When there is no phase difference, the effective current is the same as the virtual current; but as the angle of lag or lead increases, so does the value of the effective as compared with the virtual current diminish." Again (p. 87), the author refers to 'impressed or virtual electromotive force.'

These two much abused words are likewise unnecessarily dragged in; thus (p. 64) we note 'virtual or effective resistance;' (pp. 89 and 93), effective watts,' the imputation being that we, might likewise have ineffective watts! Also (p. 94) we are told that the virtual watts put into a circuit may be far in excess of the actual power conveyed!

Throughout the book the author has used terms with meanings other than those he has assigned to them by definition.

These blemishes are serious ones. With thorough revision, the book will satisfactorily meet the admirable end the author had in view.

FREDERICK BEDELL.

Anleitung zur Mikrochemischen Analyse der wichtigsten organischen Verbindungen. Von H. BEHRENS, Professor an der Polytechnischen Schule zu Delft. Viertes Heft. Karbamide und Karbonsaeuren. Mit 94 Figuren im Text. Hamburg und Leipzig, Verlag von Leopold Voss. 1897. Pp 129. Mark 4.50.

In the first number of Professor Behrens' book the anthracene group, phenols, quinones, ketones and aldehydes were considered. The second number, treating of fibrous materials, was reviewed in this JOURNAL for January 15, 1897. The third number deals with aromatic amines, and with the present number continues the work satisfactorily. It should be remembered that Professor Behrens' work is the only textbook extant in this important field.

E. R.

Die Chemie im täglichen Leben. Von DR. LASSAR-COHN. Universitäts Professor zu Königsberg. Zweite Auflage. Hamburg und Leipzig, Verlag von Leopold Voss. 1897.

The first German edition of Professor Lassar-Cohn's book was fully reviewed in this JOURNAL for January 22, 1897, by Professor Orndorff. The appearance of a second German edition, and the success of Professor Pattison-Muir's English translation show the value of the book.

E. R.

SOCIETIES AND ACADEMIES.

THE NEBRASKA ACADEMY OF SCIENCES.

THE eighth annual meeting of the Academy was held at Lincoln on November 26th and 27th. On the first day the Presidential address was given by Dr. A. S. von Mansfelde, of Ashland, his subject being 'Some Practical Applications of Science.' It was devoted largely to a discussion of the alcohol question from the scientific and medical point of view in opposition to many untenable positions taken by advocates of total abstinence.

The paper by Dr. H. B. Ward on 'Factors in Civilized Life which modify the Abundance of Parasitic Animals' in man and domestic animals dealt with the advantage of modern methods of stall-feeding, watering from wells, cleanly modes of killing and packing. Dr. E. H. Barbour reported progress on the study of Dictomaceous Earths in Nebraska. Lymnæa, Physa and Planorbis occur as fossils. The beds are furnishing excellent material for packing engine boilers as a non-conductor of heat. 'The Flora of a Dried-up Mill Pond,' by C. J. Elmore, included a list of species and a classification of them according to habit and mode of distribution. Most of the species did not occur on the adjacent bank.

Dr. C. E. Bessey presented evidence of poisoning by *Rhus radicans* without direct contact and concludes that Dr. Pfaff's non-volatile toxicodendrol may not be the only poisonous principle present or that it must be sufficiently volatile to escape in hot moist air. Dr. Roscoe Pound presented observations on the 'Abundance of Certain Secondary Species in Prairie Formations,' and showed how it may be determined quantitatively by definite count, and how misleading any other estimate is apt to be. Professor F. W. Card presented 'Notes on Root Growth,' showing that whether roots were cut back much in planting or not the new roots in any case arose mainly from the base of the roots rather than from the callus at their tips, so that best results were obtained by leaving the roots without cutting back.

Mr. H. M. Benedict discussed the generic characters of the genus *Ichthyotænia* and described a new species. Professor G. D. Swezey reported upon experiments with color screens in astronomical photography, by which an ordinary visually corrected objective gave good results in photographing bright objects.

The evening was devoted to a lecture by Mr. N. H. Darton, of the U. S. Geological Survey, on 'Some Points in the Geology of Nebraska,' with lantern illustrations, and to a banquet for members and their wives.

The first paper on November 27th, by Dr. E. W. Davis, was a discussion of certain mathematical relations between the surfaces, edges and vertices of regular solids. Miss Carrie Barbour reported upon the history and results of the Morrill Geological Expeditions. Dr. E. H. Barbour reported upon 'A Second Nebraska Meteorite,' weighing six pounds; also upon 'Our Beds of Volcanic Ash,' which are found widely distributed in the State and which furnish a very pure polishing powder. They are found distinctly stratified and fossiliferous, showing aqueous deposition.

A paper by Dr. E. W. Davis on 'Karl Pearson's Researches on the Mathematical Theory of Evolution' showed how the theory of probabilities may be used in the discussion of biological and similar data. Mr. W. D. Hunter reported upon 'Additions to Professor Bruner's List of Nebraska Birds' and upon progress in compiling lists of insects of various orders for the State. Dr. Roscoe Pound reported upon the 'Progress of the Botanical Survey of Nebraska,' particularly upon the beginnings of a study of the phytogeographic as distinguished from the mere floral aspects of the subject. Dr. R. H. Wolcott presented a paper 'On the Genus *Atax*,' giving an account of generic characters, habits and a number of new species.

For lack of time the following papers were read by title only:

The Fern Allies of Franklin county, Neb.: E. M. Hussong.

The Peat Beds and Underlying Diatomaceous Deposits along Cedar Creek and Tributaries: J. P. Rowe.

On the Experimental Proof of Faraday's Theory of Electricity: Louis T. More.

Announcement of New Nebraska Fossils: Dr. E. H. Barbour.

Observations on the Concretions of the Pierre Shale: Carrie A. Barbour.

On the Taxonomy of the Nemathelminthes: Dr. H. B. Ward.

Oolitic Sands from the Dakota Cretaceous of Nebraska: Dr. E. H. Barbour.

Some Points in the Geology of Lincoln and its Environs: C. E. Fisher.

The following officers for the ensuing year were elected:

President, Dr. H. B. Ward, Lincoln; Vice-President, Dr. A. S. von Mansfelde, Ashland; Secretary-Treasurer, Professor G. D. Swezey, Lincoln; Custodian, Professor Lawrence Bruner, Lincoln.

The meeting was the most successful one in the history of the Academy, both in attendance and in the interest manifested. Its annual volume of Proceedings is now in press, and will be larger and more fully illustrated than usual.

G. D. Swezey,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON—282ND MEETING, SATURDAY, NOVEMBER 20.

Mr. David White exhibited two specimens of Carboniferous shale from Lerkis-Bey, near Amasra, Asia Minor, on which are associated *Neuropteris Scheuchzeri* Hoffm., and *N. fimbriata* L., together with fragments of another *Neuropteris*, possibly *N. ovata* Hoffm., and two species of *Pecopteris*, one of which was *P. abbreviata* Brogn. Especial attention was called to the interesting circumstances that not only do these species appear to be identical in details with specimens similarly identified in the collection of the U. S. National Museum from the Lower Productive Coal Measures of Ohio and Pennsylvania, but that in this continent the species are also found in immediate association.

Dr. Erwin F. Smith exhibited a simple style of hypodermic syringe recently brought out by Baurch and Lamb.

Dr. Sternberg stated that it was identical in principle with one devised by himself when at Johns Hopkins University.

Professor O. F. Cook described 'A New Wingless Fly from Liberia,' stating that it was perhaps referable to the family Phoridæ, but that it represented a new genus to which the name *Wandolleckia* was given in honor of Dr. B. Wandolleck, Dipterist of the Berlin Museum. Wings, balancers and ocelli are lacking; the eyes are reduced to about forty hemispherical facets and the abdomen is membranous, the chitinous plates being rudimentary. The type *Wandolleckia achatinæ* inhabits the deep forests of Liberia, where it is found actively running about on *Achatina variegata* Roissy, the largest West African land snail. The genus may be related to *Puliciophora* Dahl, a wingless form from the Bismarck Archipelago, but is generically distinct in the much greater reduction of the abdominal plates and in the armature of the tarsi. The resemblance of both forms to fleas is probably merely superficial and has no phylogenetic implication.

Mr. V. K. Chestnut presented a paper entitled 'Some Recent Cases of Mushroom Poisoning.' The symptoms of ten cases collected by the Botany Division of the U. S. Department of Agriculture during the past year were given. Two of these were fatal to four individuals. The minor cases were caused by *Clitocybe illudens*, *Russula emetica*, *Boletus subtomentosus*, *Agaricus morganii*, a species of *Clavaria*, and the puff ball, *Lycoperdon giganteum* Batsch. One case of poisoning by the last-named species was especially noted because, although the fungus was unquestionably fresh and was properly cooked, the symptoms were very marked. The two fatal cases reported were caused by the fly amanita (*Amanita muscaria* (*L.*) *Fr.*) and the death cup (*Amanita phalloides* (L.)Fr.). It was conclusively shown by photographs, drawings and specimens that the former caused the death of Count de Vecchj in Washington on November 10, 1897, it having been mistaken for the orange amanita (*Amanita cæsarea*). The case was, however, complicated with apoplexy. Another gentleman who ate some of the same fungus was saved by repeated doses of $\frac{1}{100}$–$\frac{1}{50}$ of a grain of atropine, this being an almost perfect physiological antidote to the effects of muscarine. The seeds of Jimson weed (*Datura strammonium*) could also be used to advantage in such cases. Freshly ignited charcoal is valuable for its physical properties in absorbing the poison, and an alkaline solution of the permanganate of potash is in some cases useful as a chemical antidote. There is no antidote against the effects of phallin, the toxalbumin which causes death in *Amanita phalloides* poisoning, but in severe cases the transfusion of salt water or fresh blood is recommended. The action of the poison from the two amanitas is altogether different. Muscarine paralyzes the heart and produces marked stupor, while phallin dissolves the red blood corpuscles, causes a gradual collapse and generally leaves the brain unaffected.

Dr. Erwin F. Smith spoke on Bacterial Diseases of Plants, taking for his text certain misstatements in Dr. Alfred Fischer's recent *Vorlesungen über Bakterien.* At least ten diseases of plants are now known to be due to

bacteria. These are about equally divided between Europe and America, and there is no excuse for ignorance concerning them.

F. A. LUCAS, *Secretary.*

ZOOLOGICAL CLUB, UNIVERSITY OF CHICAGO. OCTOBER, 1897.

Two Cases of Mimicry.—The results of some observations on the mimetic habits of the Syrphid flies of the genus *Spilomyia* were presented. *S. fusca*, Leow, which is dull black-banded and spotted with yellowish white, was frequently seen flying about in the shrubbery and feeding on the honey of some golden-rods that had sprung up in a clearing in the pine woods (Price Co., Wis.). This Syrphid resembles in size, form, coloration and movements *Vespa maculata* and a smaller allied species of wasp, and was observed to occur in the same places and at the same time as these Hymenopterous models. A large female of *S. fusca* was masticated and found to have an agreeable flavor, the alimentary tract of the insect being full of honey in this instance. Therefore, warning colors are associated with the absence of disagreeable smell and taste, as the generally accepted theory of mimicry requires. In the same locality *Spilomyia quadrifasciata*, Say, was less common than *S. fusca.* It strikingly resembles the species of *Odynerus* (*O flavipes* and *O. foraminatus*), which also frequent the flowers of the golden-rods. Both insects are black, spotted and banded with bright yellow, the black predominating. The genus *Spilomyia* includes also a third group of mimics, which, like *S. liturata*, Williston, closely resemble the 'yellow-jacket' wasps (*V. germanica*, etc.). In these flies the deep yellow bands are broader and more numerous and the black coloring more restricted than in *S. fusca* and *S. quadrifasciata.*

W. M. WHEELER.

Secondary Mesoblast in the Mollusca.—Secondary mesoblast was first found in the mollusks in the lamellibranch Unio by Dr. F. R. Lillie. This secondary mesoblast was found to arise asymmetrically from a cell of the second generation of ectomeres on the left side of the egg. It subsequently becomes disposed symmetrically on both sides of the egg, apparently by a migration of some of the cells, and is mainly employed in the formation of the larval adductor muscle.

Later, secondary mesoblast was discovered in the gasteropod crepidula by Dr. Conklin. It was found to arise from the second generation of ectomeres, as in Unio, but from three quadrants instead of one, and at a much later stage of develepment than in the form studied by Lillie.

The secondary mesoblast in Physa, according to Wierzejski, and in Planorbis, according to my own observations, has a still different origin, since it arises from cells of the third generation of ectomeres on the anterior side of the egg. Its origin is symmetrical, as it arises from the two anterior quadrants of the third quartette, which lie on either side of the median plane. The divisions of the cells in the third quartette in Planorbis agree very closely with those of Physa until a late period of cleavage. In both forms the first division of the cells of the third quartette is radial ; at the next division both the upper and lower cells in the two anterior quadrants divide horizontally into equal parts. The next cleavage in the anterior quadrants is the unequal division of the lower pair of cells, each cell giving off a small cell toward the vegetal pole. In both Physa and Planorbis the upper pair of cells resulting from this last cleavage contain the secondary mesoblast. In Planorbis these cells, after dividing almost horizontally, sink into the segmentation cavity and finally lose connection with the wall of the blastula. Whether these cells are entirely converted into secondary mesoblast in Physa, as in Planorbis, appears uncertain from Wierzejski's account.

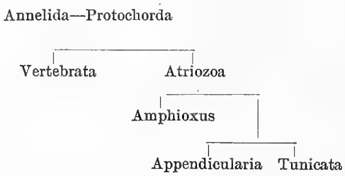
S. J. HOLMES.

Dr. Whitman gave an account of his observations concerning the results of crossing the brown and the white varieties of ring-dove, and Dr. Watase read a paper entitled 'Protoplasmic Contractility and Phosphorescence.'

During the month the following reviews of recent papers were also given: 'The Embryology of Crepidula' (Conklin), A. L. Treadwell ; 'Recent Literature on Spermatogenesis' (Meves and Hermann), W. H. Packard ; 'Structure of Nermertean Nerve-cells' (Montgomery), G. W. Hunter.

SCIENTIFIC JOURNALS.

The American Naturalist, November.—'Cephalic Homologies. A contribution to the determination of the ancestry of vertebrates,' CHARLES SEDGWICK MINOT; Advocates the following phylogeny:



'The Limits of Organic Selection,' HENRY FAIRFIELD OSBORN: Opening a discussion at Detroit already reported in SCIENCE. 'The Geological Congress in Russia,' CHARLES PALACHE. 'Some Unwritten History of the Naples Zoological Station:' An account of an address given by Dr. Anton Dohrn, at Woods Holl, on October 10th. 'Wind River and Bridger Beds in the Huerfano Lake Basin,' HENRY FAIRFIELD OSBORN. 'Peculiar Zonal Formations of the Great Plains,' FREDERIC E. CLEMENTS. 'The Cricket as a Thermometer,' A. E. DOLBEAR.

The Astrophysical Journal, November.—'The Importance of Astrophysical Research and the Relation of Astrophysics to other Physical Sciences,' JAMES E. KEELER. 'Aspects of American Astronomy,' SIMON NEWCOMB. 'The Aim of the Yerkes Observatory,' GEORGE E. HALE: Three addresses given on the occasion of the dedication of Yerkes Observatory. 'Spectroscopic Notes,' SIR WILLIAM and LADY HUGGINS: Discusses the spectra of the stars in the trapezium of the Great Nebula of Orion, the spectra of the colored components of β Cygni, the ultra violet spectra of α Lyræ and of Arcturus and on the effect of density on the spectrum of calcium. 'New Investigations of the Spectrum of β Lyræ,' A. BÉLOPOLSKY. 'On the Constitution of the Red Spectrum of Argon,' J. R. RYDBERG. 'Spectra of Bright Southern Stars,' EDWARD C. PICKERING.

The American Journal of Science, December.—'A Microsclerometer, for determining the Hardness of Minerals,' T. A. JAGGAR, JR.: Descriptions with illustration of the author's instrument. 'Recent Observations on European Dinosaurs,' O. C. MARSH: Communication made to the National Academy of Sciences, noticed in the last issue of this JOURNAL. 'Sapphires from Montana, with special reference to those from Yogo Gulch in Fergus county,' G. F. KUNZ. 'Corundum-bearing Rock from Yogo Gulch, Montana,' L. V. PIRSSON. 'Crystallography of the Montana Sapphires,' J. H. PRATT: These three papers discuss the sapphires from Montana and their petrological and crystallographic aspects. 'Electrical Measurement by Alternating Currents,' H. A. ROWLAND: Describes numerous new methods for measuring capacities, inductances and resistances. 'The Alleged Jurassic of Texas. A Reply to Professor Jules Marcou,' R. T. HILL.

NEW BOOKS.

La culture des mers en Europe. GEORGES ROCHÉ. Paris, Félix Alcan. 1898. Pp. 328. 6 fr.

Physical Problems and their Solutions. A. BOURGOUGNON. New York, D. Van Nostrand. 1897. Pp. iv+222.

La face de la terre. ED. SUESS. Translated into French by EMMANUEL DE MARGERIE and MARCEL BERTRAND. Paris, Armand Colin et Cie. Pp. 835. 5 fr.

The Strength of Materials. MANSFIELD MERRIMAN. New York, John Wiley & Sons. 1897. Pp. 124.

Report of the Commissioner of Education for the year 1895–6. Vol. 2. Washington, Government Printing Office. 1897. Pp. vii+2173.

Scientific Aspects of Christian Evidences. G. FREDERICK WRIGHT. New York, D. Appleton & Co. 1898. Pp. vii+362. $1.50.

Erratum: In the article on 'Primitive Man in the Delaware Valley' by Professor W. H. Holmes, in the last issue of SCIENCE, pages 827–8, the two cuts were placed over the wrong titles and should be transferred.

SCIENCE

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FRIDAY, DECEMBER 17, 1897.

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*SIGNALLING THROUGH SPACE WITHOUT WIRES.**

SCIENCE has conferred one great benefit on mankind. It has supplied us with a new sense. We can now see the invisible, hear the inaudible and feel the intangible. We know that the universe is filled with a homogeneous continuous elastic medium which transmits heat, light, electricity and other forms of energy from one point of space to another without loss. The discovery of the real existence of this 'ether' is one of the great scientific events of the Victorian era. Its character and mechanism are not yet known by us. All attempts to 'invent' a perfect ether have proved beyond the mental powers of the highest intellects. We can only say with Lord Salisbury that the ether is the nominative case to the verb 'to undulate.' We must be content with a knowledge of the fact that it was created in the beginning for the transmission of energy in all its forms, that it transmits these energies in definite waves and with a known velocity, that it is perfect of its kind, but that it still remains as inscrutable as gravity or life itself.

Any disturbance of the ether must originate with some disturbance of matter. An explosion, cyclone or vibratory motion may occur in the photosphere of the sun. A disturbance or wave is impressed on the

* An address given before the Royal Institution by W. H. Preece, Esq., C.B., F.R.S., M.Inst.C.E.

ether. It is propagated in straight lines through space. It falls on Jupiter, Venus, the Earth and every other planet met with in its course, and any machine, human or mechanical, capable of responding to its undulations indicates its presence. Thus the eye supplies the sensation of light, the skin is sensitive to heat, the galvanometer indicates electricity, the magnetometer indicates disturbances in the earth's magnetic field. One of the greatest scientific achievements of our generation is the magnificent generalization of Clerk-Maxwell that all these disturbances are of precisely the same kind, and that they differ only in degree. Light is an electromagnetic phenomenon, and electricity in its progress through space follows the laws of optics. Hertz proved this experimentally, and few of us who heard it will forget the admirable lecture on 'The Work of Hertz' given in this hall by Professor Oliver Lodge three years ago.*

By the kindness of Professor Silvanus Thompson, I am able to illustrate wave transmission by a very beautiful apparatus devised by him. At one end we have the *transmitter* or oscillator, which is a heavy suspended mass to which a blow or impulse is given, and which, in consequence, vibrates a given number of times per minute. At the other end is the *receiver*, or resonator, timed to vibrate to the same period. Connecting the two together is a row of leaden balls suspended so that each ball gives a portion of its energy at each oscillation to the next in the series. Each ball vibrates at right angles to or athwart the line of propagation of the wave, and as they vibrate in different phases you will see that a wave is transmitted from the transmitter to the receiver. The receiver takes up these vibrations and responds in sympathy with the transmitter. Here we have a visible illustration of that which is absolutely invisible. The wave you see differs from a wave of light or of electricity only in its length or in its frequency. Electric waves vary from units per second in long submarine cables to millions per second when excited by Hertz's method. Light waves vary per second between 400 billions in the red to 800 billions in the violet, and electric waves differ from them in no other respect. They are reflected, refracted and polarized; they are subject to interference, and they move through the ether in straight lines with the same velocity, viz., 186,400 miles per second—a number easily recalled when we remember that it was in the year 1864 that Maxwell made his famous discovery of the identity of light and electric waves.

* This is published in an enlarged and useful form by *The Electrician* Printing and Publishing Company.—W. H. P.

Electric waves, however, differ from light waves in this, that we have also to regard the direction at right angles to the line of propagation of the wave. The model gives an illustration of that which happens along a *line of electric force;* the other line of motion I speak of is a circle around the point of disturbance, and these lines are called *lines of magnetic force.** The animal eye is tuned to one series of waves; the 'electric eye,' as Lord Kelvin called Hertz's resonator, to another. If electric waves could be reduced in length to the forty-thousandth of an inch we should see them as colors.

One more definition, and our ground is cleared. When electricity is found stored up in a potential state in the molecules of a dielectric like air, glass or gutta-percha the molecules are strained; it is called a *charge*, and it establishes in its neighborhood *an electric field.* When it is active, or in its kinetic state in a circuit, it is called a *current.* It is found in both states, kinetic and potential, when a current is maintained in a conductor. The surrounding neighborhood is then found in a state of stress, forming what is called a *magnetic field.*

* *Vide* Fig. 4.

In the first case the charges can be made to rise and fall, and to surge to and fro with rhythmic regularity, exciting *electric waves* along each line of electric force at very high frequencies, and in the second case the currents can rise or alternate in direction with the same regularity—but with very different frequencies—and originate *electro-magnetic waves* whose wave fronts are propagated in the same direction.

The first is the method of Hertz, which has recently been turned to practical account by Mr. Marconi, and the second is the method which I have been applying, and which for historical reasons I will describe to you first.

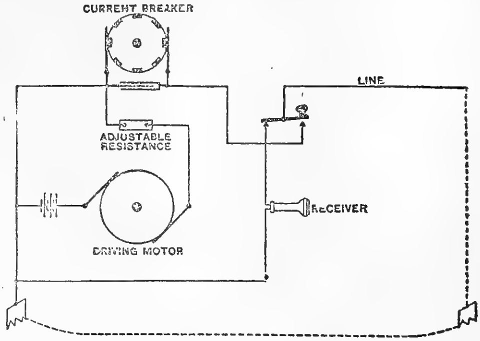

FIG. 1. Diagram of connections of Mr. Preece's system.

In 1884 messages sent through insulated wires buried in iron pipes in the streets of London were read upon telephone circuits erected on poles above the housetops, 80 feet away. Ordinary telegraph circuits were found in 1885 to produce disturbances 2,000 feet away. Distinct speech by telephone was carried on through one-quarter of a mile, a distance that was increased to $1\frac{1}{4}$ miles at a later date. Careful experiments were made in 1886 and 1887 to prove that these effects were due to pure electro-magnetic waves, and were entirely free from any earth conduction. In 1892 distinct messages were sent across a portion of the Bristol Channel between Penarth and Flat Holm, a distance of 3.3 miles.

Early in 1895 the cable between Oban and the Isle of Mull broke down, and as no ship was available for repairing and restoring communication, communication was established by utilizing parallel wires on each side of the Channel and transmitting signals across this space by these electro-magnetic waves.

The apparatus (Fig. 1) connected to each wire consists of:

(*a*) A rheotome or make and break wheel, causing about 260 undulations per second in the primary wire.

(*b*) An ordinary battery of about 100 Leclanché cells, of the so-called dry and portable form.

(*c*) A Morse telegraph key.

(*d*) A telephone to act as receiver.

(*e*) A switch to start and stop the rheotome.

Good signals depend more on the rapid rise and fall of the primary current than on the amount of energy thrown into vibration. Leclanché cells give as good signals at 3.3 miles distant as $2\frac{1}{2}$ H.P. transformed into alternating currents by an alternator, owing to the smooth sinusoidal curves of the latter. 260 vibrations per second give a pleasant note to the ear, easily read when broken up by the key into dots and dashes.

In my electro-magnetic system two parallel circuits are established, one on each side of a channel or bank of a river, each circuit becoming successively the primary and secondary of an induction system, according to the direction in which the signals are being sent. Strong alternating or vibrating cur-

rents of electricity are transmitted in the first circuit so as to form signals, letters and words in Morse character. The effects of the rise and fall of those currents are transmitted as electro-magnetic waves through the intervening space, and if the secondary circuit is so situated as to be washed by these etheral waves, their energy is transformed into secondary currents in the second circuit, which can be made to affect a telephone and thus to reproduce the signals. Of course, their intensity is much reduced but still their presence has been detected, though five miles of clear space have separated the two circuits.

Such efforts have been known scientifically in the laboratory since the days of Faraday and of Henry, but it is only within the last few years that I have been able to utilize them practically through considerable distances. This has been rendered possible through the introduction of the telephone.

Last year (August, 1896) an effort was made to establish communication with the North Sandhead (Goodwin) lightship. The apparatus used was designed and manufactured by Messrs. Evershed and Vignoles, and a most ingenious relay to establish a call was invented by Mr. Evershed. One extremity of the cable was coiled in a ring on the bottom of the sea, embracing the whole area over which the lightship swept while swinging to the tide, and the other end was connected with the shore. The ship was surrounded above the water line with another coil. The two coils were separated by a mean distance of about 200 fathoms, but communication was found to be impracticable. The screening effect of the sea water and the effect of the iron hull of the ship absorbed practically all the energy of the currents in the coiled cable, and the effects on board, though perceptible, were very trifling—too minute for signalling. Previous experiments had failed to show the extremely rapid rate at which energy is absorbed with the depth or thickness of sea water. The energy is absorbed in forming eddy currents. There is no difficulty whatever in signalling through 15 fathoms. Speech by telephone has been maintained through 6 fathoms. Although this experiment has failed through water, it is thoroughly practicable through air to considerable distances where it is possible to erect wires of similar length to the distance to be crossed on each side of the channel. It is not always possible, however, to do this, nor to get the requisite height to secure the best effect. It is impossible on a lightship and on rock lighthouses. There are many small islands—Sark, for example—where it cannot be done.

In July last Mr. Marconi brought to England a new plan. My plan is based entirely on utilizing electro-magnetic waves of very low frequency. It depends essentially on the rise and fall of *currents* in the primary wire. Mr. Marconi utilizes electric or Hertzian waves of very high frequency, and they depend upon the rise and fall of electric force in a sphere or spheres. He has invented a new relay which, for sensitiveness and delicacy, exceeds all known electrical apparatus.

The peculiarity of Mr. Marconi's system is that, apart from the ordinary connecting wires of the apparatus, conductors of very moderate length only are needed, and even these can be dispensed with if reflectors are used.

The Transmitter.—His transmitter is Professor Righi's form of Hertz's radiator (Fig. 2).

Two spheres of *solid* brass, 4 inches in diameter (A and B), are fixed in an oil-tight case D of insulating material, so that a hemisphere of each is exposed, the other hemisphere being immersed in a bath of vaseline oil. The use of oil has several

advantages. It maintains the surfaces of the spheres electrically clean, avoiding the frequent polishing required by Hertz's exposed balls. It impresses on the waves excited by these spheres a uniform and con-

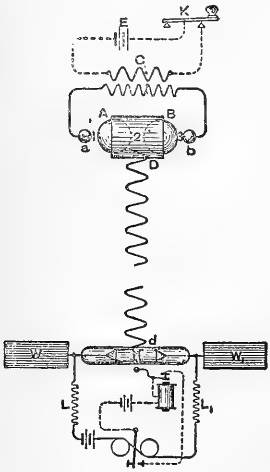

FIG. 2. Diagram of the Marconi Apparatus.

stant form. It tends to reduce the wave lengths; Righi's waves are measured in centimetres, while Hertz's were measured in metres. For these reasons the distance at which effects are produced is increased. Mr. Marconi uses generally waves of about 120 centimetres long. Two small spheres, *a* and *b*, are fixed close to the large spheres, and connected each to one end of the secondary circuit of the 'induction coil' C, the primary circuit of which is excited by a battery E, thrown in and out of circuit by the Morse key K. Now, whenever the key K is depressed sparks pass between 1, 2 and 3, and since the system A B contains a capacity and electric inertia, oscillations are set up in it of extreme rapidity. The line of propagation is D *d*, and the frequency of oscillation is probably about 250 millions per second.

The distance at which effects are produced with such rapid oscillations depends chiefly on the energy in the discharge that passes. A 6-inch spark coil has sufficed through 1, 2, 3, up to 4 miles, but for greater distances we have used a more powerful coil—one emitting sparks 20 inches long. It may also be pointed out that this distance increases with the diameter of the spheres A and B, and it is nearly doubled by making the spheres solid instead of hollow.

The Receiver.—Marconi's relay (Fig. 2) consists of a small glass tube four centimeters long, into which two silver pole-pieces are tightly fitted, separated from each other by about half a millimeter—a thin space which is filled up by a mixture of fine nickel and silver filings, mixed with a trace of mercury. The tube is exhausted to a vacuum of 4 mm., and sealed. It forms part of a circuit containing a local cell and a sensitive telegraph relay. In its normal condition the metallic powder is virtually an insulator. The particles lie higgledy-piggledy, anyhow, in disorder. They lightly touch each other in an irregular method, but when electric waves fall upon them they are 'polarized,' order is installed. They are marshalled in serried ranks; they are subject to pressure—in fact, as Professor Oliver Lodge expresses it, they 'cohere'—electrical contact ensues and a current passes. The resistance of such a space falls from infinity to about five ohms. The electric resistance of Marconi's relay—that is, the resistance of the thin disc of loose powder—is practically infinite when it is in its normal or disordered condition. It is, then, in fact, an insulator. This resistance drops sometimes to five ohms, when the absorption of the electric waves by it is intense. It, therefore, becomes a conductor. It may be, as suggested by

Professor Lodge, that we have in the measurement of the variable resistance of this instrument a means of determining the intensity of the energy falling upon it. This variation is being investigated both as regards the magnitude of the energy and the frequency of the incident waves. Now such electrical effects are well known. In 1866 Mr. S. A. Varley introduced a lightning protector constructed like the above tube, but made of boxwood and containing powdered carbon. It was fixed as a shunt to the instrument to be protected. It acted well, but it was subject to this coherence, which rendered the cure more troublesome than the disease, and its use had to be abandoned. The same action is very common in granulated carbon microphones like Hunting's, and shaking has to be resorted to, to decohere the carbon particles to their normal state. M. E. Branly (1890) showed the effect with copper, aluminium and iron filings. Professor Oliver Lodge, who has done more than any one else in England to illustrate and popularize the work of Hertz and his followers, has given the name 'coherer' to this form of apparatus. Marconi 'decoheres' by making the local current very rapidly vibrate a small hammer head against the glass tube, which it does effectually, and in doing so makes such a sound that reading Morse characters is easy. The same current that decoheres can also record Morse signals on paper by ink. The exhausted tube has two wings which, by their size, tune the receiver to the transmitter by varying the capacity of the apparatus.* Choking coils prevent the energy escaping. The analogy to Professor Silvanus Thompson's wave apparatus is evident. Oscillations set up in the transmitter fall upon the receiver tuned in sympathy with it, coherence follows, currents are excited and signals made.

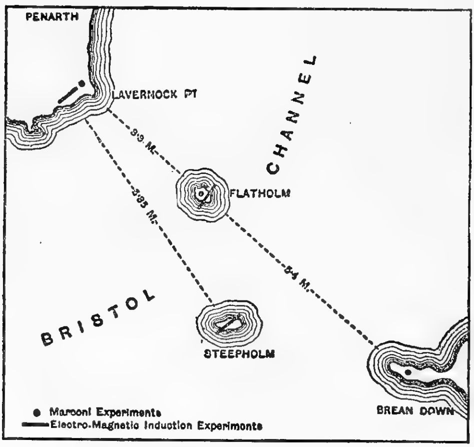

FIG. 3. Map of locality where the experiments were carried out.

In open clear spaces within sight of each other nothing more is wanted, but when obstacles intervene and great distances are in question height is needed; tall masts, kites and balloons have been used. Excellent signals have been transmitted between Penarth and Brean Down, near Weston-super-Mare, across the Bristol Channel, a distance of nearly nine miles (Fig. 3). [The system was here shown in operation.]

Mirrors also assist and intensify the effects. They were used in the earlier experiments, but they have been laid aside for the present, for they are not only expensive to make, but they occupy much time in manufacture.

* The period of vibration of a circuit is given by the equation $T = 2\pi \sqrt{KL}$, so that we have simply to vary either the capacity K or the so-called 'self-induction' L to tune the receiver to any frequency. It is simpler to vary K.

It is curious that hills and apparent obstructions fail to obstruct. The reason is probably the fact that the lines of force escape these hills. When the ether is entangled in matter of different degrees of inductivity the lines are curved, as in fact they are in light. Fig 4 shows how a hill is vir-

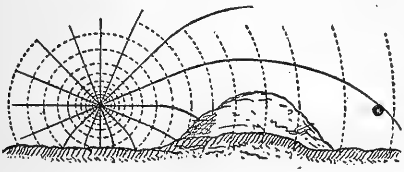

FIG. 4. Diagram illustrating the way in which hills are bridged by the electric waves.

tually bridged over by these lines, and consequently some electric waves fall on the relay. Weather seems to have no influence —rain, fogs, snow and wind avail nothing.

The wings in Fig. 2 may be removed. One pole can be connected with earth, and the other extended up to the top of the mast, or fastened to a balloon by means of a wire. The wire and balloon or kite covered with tin foil becomes the wing. In

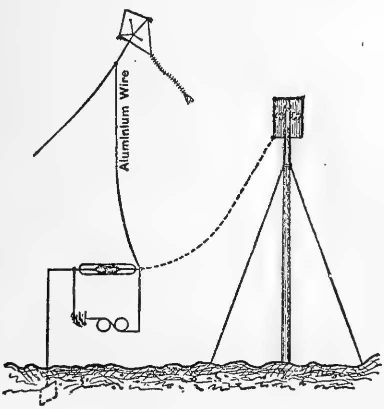

FIG. 5. Diagram of Marconi connections when using pole or kite.

this case one pole of the transmitter must also be connected with the earth. This is shown by Fig. 5.

There are some apparent anomalies that have developed themselves during the experiments. Mr. Marconi finds that his relay acts even when it is placed in a perfectly closed metallic box. This is the fact that has given rise to the rumor that he can blow up an iron-clad ship. This might be true if he could plant his properly tuned receiver in the magazine of an enemy's ship. Many other funny things could be done if this were possible. I remember in my childhood that Captain Warner blew up a ship at a great distance off Brighton. How this was done was never known, for his secret died shortly afterwards with him. It certainly was not by means of Marconi's relay.

The distance to which signals have been sent is remarkable. On Salisbury Plain Mr. Marconi covered a distance of four miles. In the Bristol Channel this has been extended to over eight miles, and we have by no means reached the limit. It is interesting to read the surmises of others. Half a mile was the wildest dream.*

It is easy to transmit many messages in any direction at the same time. It is only necessary to tune the transmitters and receivers to the same frequency or 'note.' I could show this here, but we are bothered by reflection from the walls. This does not happen in open space. Tuning is very easy. It is simply necessary to vary the capacity of the receiver, and this is done by increas-

* "Unfortunately at present we cannot detect the electro-magnetic waves more than 100 feet from their source." Trowbridge, 1897, *What is Electricity*, p. 256.

"I mention 40 yards because that was one of the first out-of-door experiments, but I should think that something more like half a mile was nearer the limit of sensibility. However, this is a rash statement not at present verified." Oliver Lodge, 1894, *The Work of Hertz*, p. 18.

ing the length of the wings W in Fig. 2. The proper length is found experimentally close to the transmitter. It is practically impossible to do so far away.

It has been said that Mr. Marconi has done nothing new. He has not discovered any new rays; his transmitter is comparatively old; his receiver is based on Branly's coherer. Columbus did not invent the egg, but he showed how to make it stand on its end, and Marconi has produced from known means a new electric eye more delicate than any known electrical instrument, and a new system of telegraphy that will reach places hitherto inaccessible. There are a great many practical points connected with this system that require to be threshed out in a practical manner before it can be placed on the market, but enough has been done to prove its value, and to show that for shipping and lighthouse purposes it will be a great and valuable acquisition.

CHARACTERS, CONGENITAL AND ACQUIRED.

The characters of a living organism, plant or animal, are usually grouped by biologists under two heads, the congenital, or inborn, and the acquired. But hitherto no systematic attempt has been made to give precision to these terms—to define precisely what we mean by them, and in the case of any particular organism to ascertain exactly which of its characters are inborn and which acquired. I know nothing in the whole range of science which promises to the thinker more immediate and solid results than this strangely neglected field of investigation. For example, had it received the attention it deserved, it is probable that the great controversy as to the transmissibility of acquired traits between the Neo-Lamarckian and Darwinian schools would long ago have ceased, since only after it has been definitely determined whether this or that trait is inborn or acquired can the fact of its transmissibility or non-transmissibility profitably be used as an argument for or against the Lamarckian doctrine. This precisely the disputants have not done—an assertion I shall justify presently. To deal with my subject adequately one should have the powers of a Darwin or a Herbert Spencer; if, however, I can contrive to direct attention to it I shall be well content.

An inborn variation may be defined as one which arises in an organism owing to changes previously produced by the action of the environment in the germ cell (or pair of germ cells) whence it sprang. As inborn variations are admittedly transmissible, all inborn characters must have arisen thus in the ancestry* and, deductively, it must follow, as, indeed, may easily be proved inductively,† that changes in a germ cell tend to be reproduced in its descendant germ cells, for which reason the organisms that arise from them tend also to reproduce the inborn variations of the parent organism.

An acquired character may be defined as one which arises in the organism owing to changes produced by the action of the environment, not on the germ cell, but on the somatic cells derived from it. If acquired modifications are transmissible, then changes in the somatic cells must tend so to modify the germ cells associated with them that, as a consequence, the organisms they proliferate into tend to reproduce, as inborn characters, the *particular* variations which were acquired by the parent organism.

* That is, if we accept the Neo-Darwinian doctrine.

† All unicellular organisms are germ cells; that is, they are all capable of continuing the species. When modified by the action of the environment they tend to transmit their modifications to descendant organisms, as has been abundantly proved by bacteriologists. A striking example is afforded by the organism which produces small-pox. If transferred to the cow it becomes so modified in the new environment that it ever afterwards causes in man, not small-pox, but cow-pox.

I dare say that the above definitions will be objected to by some of my readers, but I am in hopes that, on consideration of what follows, the majority will assent to them as indicating pretty correctly what we really mean by the terms 'inborn' and 'acquired.' I do not here propose to discuss the question as to whether acquired modifications are transmissible; I have done it at length elsewhere, and my present object is rather to differentiate accurately between the acquired and the congenital, and to ascertain the parts played by them respectively in the organic world. I may, in passing, however, notice one or two points which have been frequent sources of confusion and the consideration of which may help to bring the meaning I intend my definitions to bear clearly before the mind.

It has often been maintained by Neo-Lamarckians that important modifications in the soma (*e. g.*, the effects of disease) *must* affect the associated germ cells, and that therefore acquired modifications *must*, to some extent, be transmissible.* They miss the point at issue. It is not denied that changes in the germ's environment (*i. e.*, in the body of the parent) may result in modifications in the organism into which the germ subsequently proliferates, but it is strenuously denied that acquired modifications in the parent tend specially so to modify the germ as to cause the organism into which it subsequently proliferates to reproduce congenitally the particular modification which the parent acquired. Again, supposing some cause (*e. g.*, disease) produced a modification (*e. g.*, cavities in the lungs) in the soma and that subsequently, in the absence of the cause, the offspring developed the modification; even this would not constitute an absolute proof of the Lamarckian doctrine, though it would raise a presumption in favor of it. For it must be remembered that it is not asserted that a force acting on an organism cannot produce such a change in the germ as will cause the organism into which it develops to exhibit a variation similar to the modification produced by the force in the parent, but that it is asserted that this coincidence, this mere coincidence, must, from the nature of the case, be extremely rare, so very rare that, as factors in evolution, such apparent, but only apparent, transmission of acquired traits may practically be ignored. Only after it had been shown that clear and indubitable cases of reproduction by the offspring of the parents' modification were not uncommon in nature could the truth of the Lamarckian doctrine be accepted as proven.

Watching the multiplication of an infusorian (*Stylonychia Pustulata*), Maupas observed that, after two of these had conjugated, the resulting fertilized cell divided and redivided many times without conjugation again occurring, but that if, after a certain pretty definite number of cell-divisions, conjugation did not again occur, the race ultimately died out. He found, moreover, that the descendants of a conjugated pair did not conjugate among themselves, but only with the descendants of another conjugated pair. All this is the rule among higher plants and animals. The ovum and the sperm are unicellular organisms. After conjugation they divide and redivide many times without conjugation again occurring among the descendant cells. But these, like the infusorians, if they do not conjugate, ultimately die out. Most of them (*i. e.*, the somatic cells) are incapable of conjugation, while such of them as are capable of conjugation (*i. e.*, the germ cells) conjugate only with cells

* "The germ is a unicellular organism and therefore it should be modifiable in accordance with its environment. Such environment would be different in the body of a sedentary clerk and a hard-working agricultural laborer, and on this hypothesis the offspring in these cases would be different." (S. S. Buckman, *Natural Science*, March, 1897, p. 189.)

from another body (*i. e.*, cell-family). There are, as is well known, exceptions to the above; unending reproduction may occur without conjugation, as among such plants as are propagated by slips or suckers, and self-fertilization also occurs, but the general rule is as I have stated. A multicellular plant or animal in the successive stages of its development is therefore the homologue, not of the remote ancestral unicellular organism, but of all those successive generations of unicellular organisms which intervene between one act of conjugation and the next.

Unlike the cell descendants of a conjugated unicellular organism, the cell-descendants of a conjugated germ differ from it, and from one another, in that they undergo differentiation along certain definite lines (into nerve, muscle, bone, etc.), the germ cells being so specialized that the cell-communities which spring from them are very like the cell-community of which they were cell-members, for which reason a man, for instance, is like his parent. Moreover, the cell-descendants of the conjugated germ differ from the cell-descendants of the conjugated unicellular organism in that they remain adherent, and in that, in different lines of descent, they multiply at different though definite rates. Did the cell-descendants of the germ all multiply at an equal rate, a solid spherical mass of cells would, of course, result; whereas, owing to differences in their rates of multiplication, the shape of multicellular plants and animals are irregular (*i. e.*, not spherical). But, though these rates of multiplication in different lines of descent are pretty definite in every species of plant and animal, they differ widely in different species, whence arise differences in shape betwixt one species and another. An ox, for instance, differs in shape from a man because in it the cells in different lines of descent do not multiply at the same rate as in the man.

We cannot doubt that, when first multicellular organisms were evolved from unicellular, all the cells constituting the mass were morphologically and physiologically similar, and that, therefore, like the ancestral unicellular organism, every cell was capable of performing all the functions of life—food-getting, locomotion, reproduction of the race, etc. Later, as a result of natural selection, differentiation appeared among the adherent cells of the community, some taking on one function and some another, till at length a high degree of differentiation resulted, and the reproduction of the race was delegated to the germ cells.

As I have already indicated, among the unicellular organisms every cell is a germ cell, and as such is capable of continuing the race. Among low multicellular organisms this power persists in many cells, and the environment decides whether it shall be exercised or not; thus, if almost any fragment of a sponge be bedded out it will proliferate into a complete individual. It persists longer in plants than in animals; thus from a fragment of begonia leaf may arise an entire individual capable of continuing the race; the cells are being turned from their original destiny by a change in the environment. But among the higher plants this power of reproducing the entire individual by means of cells other than germ cells, or what may normally proliferate into germ cells, is very exceptional. All that commonly persists is the power of reproducing from such fragments of the complete organism as contain cells, which might normally proliferate into germ cells, the parts wanting to render the fragment a complete organism. Thus a geranium slip (for instance) contains cells which normally (*i. e.*, when the branch remains part of the plant) proliferate into germ cells; if this branch be bedded out as a slip it produces the roots which are needed to convert it into a complete organism of its

species. Here germ cells are not produced from cells not destined to that purpose as in the begonia leaf, but lost parts are reproduced by what may be termed (and in fact is) an exaggerated process of healing. In other plants the power of reproducing lost parts is present in a much smaller scale, and only comparatively trifling injuries are healed; *i. e.*, a small fragment cannot reproduce the whole, though the whole can reproduce lost fragments. Among animals, owing to the greater specialization of the cells and the more complex condition under which they live, this power of reproducing lost parts is present in general to a much less extent than among plants. Low in the scale, as we see, a fragment of sponge, for instance, can reproduce the whole. Higher in the scale, a starfish can reproduce a ray, a lobster a claw, a lizard its tail, and so forth, but none of these parts can reproduce the whole; that is done solely by germ cells. Higher yet, as among birds and mammals, the power of reproducing lost parts is comparatively very trifling; important and complex parts cannot be restored. Wounds and mutilations are healed, but, if serious, very imperfectly, for only scar tissue replaces the normal tissues which were lost.

We see, then, that the reproduction of lost parts, whether it be on a very great and perfect scale, as when a fragment reproduces a whole as in a sponge, or whether it be on a very small and imperfect scale, as when a wound is healed in one of the higher animals, is a process of the same order. Now, we speak of a scar in man, for example, as an acquired character; but who would dream of speaking of all that which is reproduced by the fragment of a sponge or a begonia leaf as a character acquired by the fragment. Moreover, when one of the higher animals is mutilated, as when a dog loses his tail, we lump together both the mutilation and the tissue with which the lost part is replaced (*i. e.*, the scar) as a single acquired character. But, even if we should agree for convenience to regard the scar as an acquired character, surely the mutilation ought not to be so designated, but should rather be termed (as I venture to suggest) *an enforced* character. We see, moreover, that the power of reproducing lost parts to a greater or less extent persists throughout organic nature, but that this power is vastly greater low in the scale than higher. In other words, if we agree to regard such reproductions as acquired, observation proves that the power of acquiring them is very much greater low in the scale (*e. g.*, sponge) than it is higher (*e. g.*, man).

On the other hand, there is another class of acquired characters—*perhaps the only class to which the term should properly be applied*—the power of acquiring which is greatest among the highest animals, and apparently is little or not at all present among the lower animals, nor in the whole of the plant world. I speak of such characters as arise as a result of exercise and use, as, for instance, the increased muscular power of an athlete. In the plant world no characters can, of course, be acquired as a response to the stimulation of exercise and use. Plants, therefore, of necessity, attain their full development in the absence of all other stimulation than such as is supplied by sufficient food and warmth. Of such plant-like animals as sponges the same also, of necessity, is true. It is true, with possible exceptions, even of such active animals as insects. Thus a pupa may develop into a perfect insect while lying quiescent. The lower vertebrates, such as fish and reptiles, have also little or no power of developing in response to the stimulation of use and exercise; apparently they are able to grow into normal, adult animals in its absence; thus if a tadpole finds its way through a crevice into a small cavity, and is able to obtain sufficient food, it develops

into a normal frog, though it leads a purely vegetative life. Higher yet in the scale among birds and mammals, and most of all among the highest mammals, the animal attains its full development, as regards many structures, only in response to the stimulation of exercise and use; thus, for instance, if the limb of an infant be locked by paralysis or by a joint disease so that it cannot be used it does not develop into an adult limb. Now, if a 'normal' man takes a more than ordinary amount of exercise he gets a more than ordinary development of various structures, as happens in the case of the blacksmith's arm. This extra development is regarded by biologists as 'abnormal' and is rightly termed 'acquired.' But, as we see, the 'normal' degree of development is attained only as a response to exercise (*i. e.*, stimulation), similar in kind though less in amount. *Therefore, it is clear that the full development of the normal adult arm, as well as many other important structures, is acquired*, differing in this from eyes, ears, teeth, nails, etc., which are wholly inborn, and do not owe their development in the least to use and exercise. In fact, on consideration, I think it will be found that adult man differs physically from the infant almost wholly in characters which are acquired, not in those which are inborn. In teeth, hair, skull-bones, genital organs, and in some other respects, he differs from the infant as regards inborn characters; but as regards almost all the structures of the trunk and limbs, and most of those of the head, the difference is in characters which have been acquired by the adult as a response to the stimulation of exercise and use. Thus the limbs develop wholly in response to use, the heart and arteries develop within certain limits in proportion to the strain put on them, as also do the lungs and their accessory muscles, as well as the bony attachments of the latter. The muscles, arteries, nerves, etc., of the head and neck also develop in response to the same stimulation. Moreover, the normal standard of development is maintained only as a response to this stimulation (*i. e.*, use, exercise), for example, when not used, the muscles with their coördinated structures atrophy and tend to disappear, as in the case of a paralyzed limb. It may be added that it is probable that even the infantile standard of development is, to some extent, acquired under the stimulus of fœtal movements in utero.

In upholding the doctrine of the transmissibility of acquired modifications much stress has been laid by Mr. Herbert Spencer and others on the exquisite coördination of the multitudinous parts of the high animal organism. They maintain that this coördination affords decisive proof of the Lamarckian theory, the line of argument being as follows: It is not probable that all the many structures of a high animal can ever have varied favorably together (as compared to the parent) in any individual animal. It is unbelievable that they can all have varied favorably generation after generation in a line of individuals. A chain is only as strong as its weakest link. A favorable variation, say a larger horn in the elk, if unaccompanied by corresponding variation in all the thousand parts (in head, neck, trunk, limbs) coördinated with it, would be useless, and even burdensome. In other words, if a single structure (muscle, bone, ligament, etc.) of all those associated with it failed to bear the strain of the larger horn, this variation would not favor survival, but, on the contrary, be a cause of elimination. Therefore, say these thinkers, the evolution of high multicellular animals cannot be attributed to the accumulation, during generations, of inborn variations alone, but must in part be attributed to the accumulation, during generations, of the effects of use and disuse, *i. e.*,

to the accumulation of acquired variations.

But variations acquired as a result of use and disuse are plainly never transmitted. Thus an infant's limb never attains to the adult standard except in response to the same stimulation (exercise) as that which developed the parent's limb. The same is true of all the other structures which in the parent underwent development as a result of use, or subsequent retrogression in the absence of it. These, like the limbs, do not develop or retrogress in the infant except as a result of similar causes. Plainly, then, what is transmitted to the infant is not the modification, but only *the power of acquiring it under similar circumstances*—a power which has undergone such an evolution in high animal organisms that, as I say, in man, for instance, almost all the development changes which occur between infancy and manhood are attributable to it. It follows, therefore, that the exquisite coördination of all the parts of a high animal is not due to the inherited effects of use and disuse, but to this great power of acquiring modifications along certain definite lines; so that if an animal varies in such a way as to have one of its structures (*e. g.*, horn, a structure which is wholly inborn) larger than in the parent, then all the other structures associated with it, owing to the increased strain (*i. e.*, the increased stimulation) put on them, undergo a corresponding modification, and thus preserve the harmony of all the parts of the whole. So also if the horn (for instance) be smaller than in the parent, the lesser strain placed by it on associated structures causes these also to develop less than in the parent, whereby again the harmony of the whole is preserved.

I have dwelt at greater length on this neglected subject of acquired characters (properly so-called) elsewhere,* but I think I have said enough even here to demonstrate its immense importance. The power of acquiring fit modifications in response to appropriate stimulation is that which especially differentiates high animal organisms from low animal organisms.* Without this power and the plasticity which results from it the multitudinous parts of high animals could not well be coordinated, and, therefore, without it their evolution could scarcely have been possible. Indeed, it is not too much to say, so vitally important is this power to the higher animals, that, as regards them, the chief aim (if I may use the expression) of natural selection has been to evolve it. But, since this power of developing in response to the stimulation of use operates mainly along certain definite lines, which are not quite the same in every species, the different species differ as regards size and shape, not only in characters which are inborn, but also in those which are acquired. Thus an ox differs in size and shape from a man not alone in inborn characters, but also in characters which are acquired as a result of exercise and use. The structures of both the ox and man develop in response to appropriate stimulation, but not quite in the same direction, nor in the same proportion, nor to the same degree; hence, to some extent the differences in size and shape betwixt the two animals. Consider, for instance, the hind limbs of the ox and man: in both these grow greatly as a response to the stimulation of exercise, but the lines of growth being somewhat different the limbs do not approximate in shape and size. Presently, when we consider mind, we shall realize even more strikingly the importance of our subject, and perceive how deeply it concerns many fields of thought and investigation which have greatly interested mankind in all ages; but I have still something more to say as regards

* Vide *The Present Evolution of Man*, pp. 108–21.

* The truth of this, as we shall see, is made particularly manifest by the study of mind.

physical characters, though it is not possible in the space allotted me to do full justice to the theme.

G. ARCHDALL REID.

SOUTHSEA, ENGLAND.

THE DESIRABILITY AND THE FEASIBILITY OF THE ACQUISITION OF SOME REAL AND ACCURATE KNOWLEDGE OF THE BRAIN BY PRE-COLLEGIATE SCHOLARS.*

NEVER before has the need of information as to the structure and function of the nervous system been so keenly felt by experts in various branches of knowledge and by practitioners of various specialties.

Never before, likewise, has there been so general and so earnest a desire for such information among the laity. For the first time has it been claimed by a prominent educator that neurology is a prime constituent of a liberal education. Among the branches of knowledge essential to a liberally educated man President Gilman names (*Educational Review*, III., 105–119, February, 1892), "first, the knowledge of his own physical nature, especially of his thinking apparatus, of the brain and the nervous system, by which his intellectual life is carried forward."

Under prevailing conditions, however, any approximation to a real and accurate knowledge of the brain is gained by but few, and at a late educational stage. Hence the public are ignorant or misinformed,* and the time that specialists might devote to research and advanced instruction is consumed in acquiring and im-

* This article is based upon a paper presented at the meeting of the American Society of Naturalists in Boston, December 29, 1896; it is an extension of the views expressed by that Society in 1891, 1892 and 1893 regarding a science requirement for admission to college and the introduction of natural history studies into the lowest grades of schools. It also embodies the substance of published or unpublished remarks upon the subject made by the writer on the following occasions:

1889.—In the article 'Anatomical Terminology,' Reference Handbook of the Medical Sciences (VIII., p. 532, § 82), occurs the following passage: "Aside from prejudice and lack of practical direction as to removing, preserving and examining the organ, there is but one valid reason why every child of ten years should not have an accurate and somewhat extended personal acquaintance with the gross anatomy of the mammalian brain; that obstacle is the enormous and unmanageable accumulation of objectionable names under which the parts are literally buried."

The foregoing paragraph is reproduced in a footnote upon p. 335 of my paper, 'Neural Terms, International and National,' *Jour. Comp. Neurology*, VI., 216–352, December, 1896 (issued February, 1897).

1896, a.—An address before the Home Congress, in Boston, October 13, 1896, was entitled 'Brains for the young: the desirability and the feasibility of the acquisition of some real knowledge of the brain by precollegiate scholars.' Through misapprehension a report of the address was printed in the *Arena* for March, 1897, pp. 575–583. Although unauthorized and containing some errors, it fairly represents what was said.

1896, b.—At the meeting of the New York State Science Teachers' Association in Buffalo, December 31, 1896, in the discussion on Biology in the Schools, the main points of the article above named were briefly stated; they were correctly reported in SCIENCE, April 2, 1897, p. 537.

1897.—A paper on 'The practical study of the brain in a primary school' was read before the University Convocation, June 29, 1897.

*Among the anxious parents and teachers to whom they are addressed how many are able to profit by the information contained in, for example, Donaldson's 'The growth of the brain' and Halleck's 'The education of the central nervous system?' How many persons recognize as erroneous the statements so frequently made as to the supreme absolute or relative size of the human brain? May not high school pupils describe the rivers of Africa and even the 'canals' of Mars and yet be so little familiar with the topography of the cerebrum as to accept without question the alleged representations thereof in most text-books, misrepresentations that might serve equally well for a heap of sausages? A large part of the community is at the mercy of charlatans, and squanders time and money upon that peculiarly American humbug, phrenology as practised. In a recent issue of a popular magazine, whose editor is sincerely interested in education, is an article containing not merely the phrenologic misstatements and vapidities, but a diagram of the 'convolutions of the brain' which has no basis of fact.

parting the neurologic alphabet. Indeed, so numerous are the parts of the central nervous system,* so heterogeneous and unfamiliar are their appellations,† so complex are their connections, so subtle and interdependent are their operations, so multifarious and difficult are histologic and physiologic manipulations, so diverse are the interpretations of nervous phenomena, and so voluminous is the literature of neurology,‡ that by the time existing knowledge is fairly mastered the would-be investigator has too often passed the period of greatest energy, enthusiasm and opportunity.

Were the practical study of the brain commenced in the primary schools two results might be anticipated, viz.:

First, the more general and thorough comprehension of the references to the structure, functions, disorders and injuries of the brain that occur with increasing frequency in lay as well as professional publications.

Secondly, among the many thus early and systematically trained in the fundamentals of neurologic fact, theory, method and literature, such as were fitted by nature and nurture to increase knowledge would be several years in advance of investigators as now prepared.

My general proposition is that *a certain amount of study of the vertebrate brain constitutes an indispensable element of every course at every educational stage; that this study be objective; that dissections and drawings§ be imperatively required; and that the forms and methods employed, and the ideas and generalizations inculcated and elucidated, be adapted to the average mental condition at the several epochs.*

The following remarks and quotations may serve to introduce an outline of neurologic study and to avert some possible objections.

The human brain is commonly the ultimate object of inquiry, but it is so difficult to obtain, preserve, manipulate and comprehend that animal brains are more conveniently employed at first. *Fiat experimentum in corpore vili.*

Descriptions, pictures and models may serve to convey additional information to such as are already fairly well informed; but there should first be laid a concrete foundation composed of direct personal impressions of the object, manual as well as visual.

Other things being equal, the acquisition of advanced knowledge is rapid and perfect in direct ratio with the earliness and thoroughness of appropriate preliminary training.*

The higher a material superstructure, the deeper are laid its foundations. If, therefore, as stated by Minot, the human brain is the most complex organ known, and if the human intellect is destined to be long baffled by the mysteries of its own agent, so much the rather should the fundamental facts and ideas of neurology be firmly fixed in the vacant and receptive depths of the youthful mind.

Because the elaborations of a science tax the mental powers of the philosopher is no reason for postponing its rudiments un-

*Including the meninges and blood-vessels, there are between five and six hundred; see the lists compiled by the committee of the Anatomische Gesellschaft and by the writer; 'Neural Terms,' etc., 1896.

†In 1888 the total in all languages was 10,500; see 'Neural Terms,' etc., pp. 230–231.

‡The card-catalogue prepared in the neurologic laboratory of Cornell University refers mainly to vertebrates and includes between five and six thousand titles.

§In a recent discussion of 'Physiology in the Schools' (University Convocation Report, 1896, p. 74) I have declared my belief that "children should be taught to draw before they write."

*In a very different connection it has been declared by Professor W. W. Goodwin (*The Nation*, October 24, 1895, 'School English') that "whatever study is to be pursued with effect must have its foundations laid before the age of fifteen."

til old age. At one extreme of astronomy are problems of the universe; but at the other is the recognition of the more conspicuous stars.

Mere memorizing becomes more and more irksome and difficult with age, while the youthful mind has been well characterized as 'wax to receive and adamant to retain.' Hence the desirability of the early acquisition of the main facts and terms of neurology.

Children have no prejudices against words of classical origin. *Hippocampus*, *rhinencephalon*, *hypophysis*, *fornix* and *callosum* would be accepted quite as readily as *hippopotamus*, *rhinoceros*, *hypotheneuse*, *appendix* and *chrysanthemum*.

Other things being equal, the readiness with which a new term is assimilated is in direct ratio with the completeness of the impression associated therewith. The pupils who succeed in remembering the names of mountains (*e. g.*, Himalayas) which few can anticipate visiting, and of ancient warriors (*e. g.*, Agamemnon) whose features are unknown to them, will promptly accept and firmly retain the designations of parts of their own bodies, especially when those same parts, obtained from animals, are not merely seen by them, but handled and dissected.

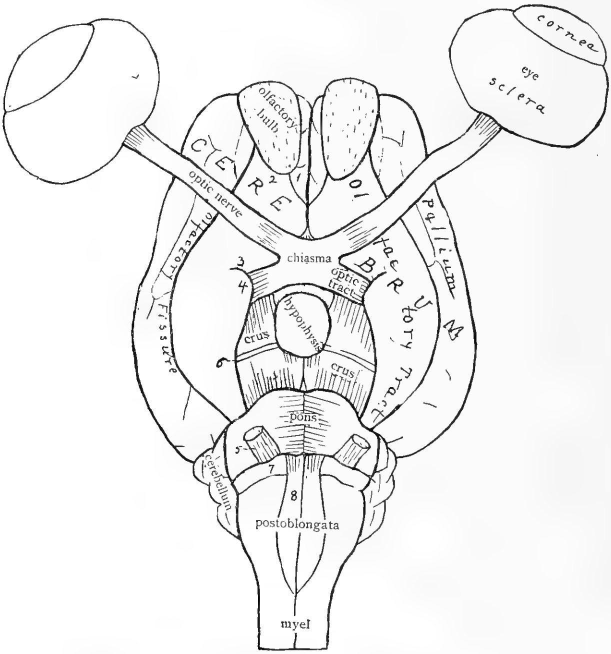

FIG. 1. Base or ventral aspect of the sheep's brain with the eyes attached; slightly enlarged. From the writer's 'Physiology Practicums,' second edition, 1895.

Children are spontaneously interested in natural objects. Like the terror of dogs, the squeamishness that would induce reluctance to handle a 'specimen' is commonly an artificial condition induced by the ignorant or thoughtless interference of parents or teachers. Left to itself the healthy child sucks in knowledge through its finger-tips.

Paradoxical as it may at first appear, notwithstanding the extreme complexity of its ultimate structure, as a gross object the brain is the easiest of all the viscera for the beginner. It is symmetric, and the main divisions are clearly outlined; moreover its colors are attractive, it retains little blood, the natural odor is not offensive, and it has no unpleasant associations.

If it be legitimate to slaughter animals for food, it is even more so to kill them humanely (as with chloroform) in order to gain information. This is particularly true of the superfluous cats and dogs that lead miserable lives in most cities. Children should be taught that the greatest kindness toward such is a speedy and painless death.

The two following sentences, from an artist and a philosopher, respectively, embody profound truths as to physical and metaphysical methods in any branch of study. According to Philip Gilbert Hamerton, "Personal familiarity alone makes knowledge alive." Joseph Henry declares that "In the order of nature, doing comes before thinking, art before science."

Huxley and Wm. North Rice have emphatically condemned the maxim, "A little knowledge is a dangerous thing." Ignorance alone is perilous, and in proportion to its density.

The practical study of the brain in educational institutions below the college may conveniently form three stages, corresponding with the primary school, the grammar and intermediate schools and the high school. At all three stages actual specimens are to be used and drawings are to be made.

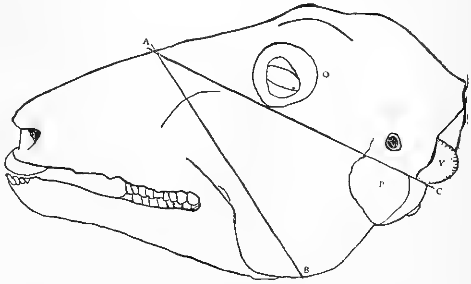

FIG. 2. Head of sheep skinned. Along the line A–B the butcher may cut so as to remove most of the face; the line A–C indicates the plane of section with a saw for removing the cranium.

In the primary stage there is to be mainly *observation* with the unaided eye, and simple manipulation. A sheep's brain* is to be examined by each pupil; but there should be shown also preparations exhibiting the location of the brain in the head, its continuity with the myel (spinal cord), and its connection with the eyes and larger cranial nerves; also preparations, models or charts of corresponding aspects of the human brain. Few terms need be employed, but the parts should become familiar as the features of the face. For further details see the description of an application of the plan in the latter part of this article.

* In most localities where neurology is likely to be considered the heads of sheep may be had in abundance, at a trifling cost, and without involving the killing of the animals for the purpose. In varying degrees the same may be said of calves, pigs and oxen. Sometimes the butchers can be employed to extract the brain after a rough fashion as if for food; but it is removed most safely and easily according to the method devised by P. A. Fish, described by me before the American Society of Naturalists, in 1890, and indicated upon Figures 2 and 3.

In the grammar* school observation is to be extended to *comparison*; with the sheep's brain as a standard the brains of cats and dogs and rabbits are to be examined, drawn and dissected in the same way. All the cranial nerves may be identified. The general nature of cerebral fissures may be considered, and certain special points elaborated, *e. g.*, the distinction between the

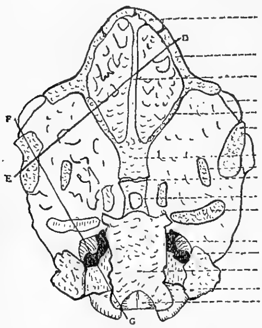

FIG. 3. Ventral aspect of the cranium after removal along the line *A–C*. If the parts outside the line *D–E* and *F–G* are sawn off the brain may be exposed with nippers.

fissures of the cat and of the dog; the difference between the right and the left; the extent of individual variations. Pigs, kittens and puppies† at various ages, before and after birth, may illustrate changes in the form and proportions of parts. A lens may be required for some purposes. The fibrous nature of the white portions may be demonstrated upon hardened specimens.

* In his admirable address, 'Science Teaching in the Public Schools,' (*Amer. Soc. Naturalists*, 1897; *American Naturalist*, September, 1888; also with Appendices, D. C. Heath & Co., 1889), Wm. North Rice assigns the nervous system to the fifth of the nine grades recognized in the primary and grammar schools; but there is also an implication that the study of the brain as an object is to begin in the high school.

† Fetal pigs may usually be obtained at any large slaughter-house.

In the high school, with further observation and comparison should be associated *reflection*. The pupil should be led to recognize the segmental constitution of the brain, and the modifications of the several segments. For this purpose, after a trial of several forms, I believe the brain of the large Green turtle (*Chelone mydas*) of the Atlantic is most available.* The severed heads may be obtained from city hotels, and the brain readily exposed by sawing off the larger part of one side. Afterwards may be studied the brains of other turtles, of salamanders, of lizards and of small mammals, and finally those of frogs and birds. The compound microscope should now be employed for the demonstration of cell-clusters and fiber-tracts in certain regions. In every high school there should be at least one well preserved adult human brain; also that of a monkey. The main resemblances and peculiarities of the former may then be illustrated. Each pupil should have an opportunity of studying the topography of the human cerebrum, and the general arrangement of the fissures should be as familiar as the river systems of his native country. The order of formation of the fissures should be shown upon a series of fetal brains, or models or diagrams thereof.

The foregoing outline is not assumed to be complete or perfect, and the experienced teacher will of course modify the details in accordance with the circumstances.

An opportunity for a partial test of its validity was afforded last spring with a class of forty boys and girls between seven

*Even were the commonly employed brain of the frog not too small, the insignificance of the cerebellum and the secondary fusion of the olfactory bulbs are apt to occasion misconceptions. Indeed, so aberrant is the structure of the frog in most respects that the ease and safety with which it may be obtained, kept alive and experimented upon, constitute a real and considerable bar to the formation and diffusion of sound morphologic ideas.

and eleven years old in the second grade of a primary school. Among the fathers of these children half a dozen are day-laborers and as many more teachers or clergymen, the majority being mechanics or tradesmen.

With the approval of Superintendent H. W. Foster, of the Ithaca Schools, and the cordial cooperation of the teacher, Mrs. H. A. Surface, but with absolutely no advance intimation to the pupils themselves, on the 26th of April there was placed before each of the forty a hardened sheep's brain. During one-third of the half-hour exercise the pupils made drawings of the dorsal aspect of the brain. The rest of the time was spent in discussing the form and naming the main features by the aid of the blackboard. At a second exercise the base was drawn (Fig. 3). At a third each brain had been transected at two levels, *viz.*, between the cerebrum and the cerebellum, and through the frontal part of the cerebrum. After considering the contours and colors of the regions thus exposed, the middle piece was held under water, and air blown into the single orifice in the mesencephal; its escape through the two cerebral orifices demonstrated the continuity of the cavities.

Most of the pupils manifested an eager interest, and only one or two a slight disinclination to handle the specimens.

Twenty names were introduced, nearly in the following order: *cerebrum, cerebellum, olfactory bulb, oblongata, spinal cord,** *arachnoid, pons, chiasma, optic nerve, hypophysis, crus, alba, cinerea, cortex, cavity, endyma, fissure, gyre, pia* and *callosum*. After an interval of nearly two months, at an unannounced examination, most of the pupils were able to recall the main features and their names.

Lest it be hastily inferred that I advocate the introduction of the study of the brain as an isolated branch of biology, let me state, first, that the laws of New York prescribe instruction in physiology for all grades; secondly, that the three lessons above mentioned were merely the last of a series of thirty given by me to the same class, all illustrated by specimens and simple experiments. For the encouragement of others who may desire to further the establishment of objective science teaching in the public schools, it may be added that evidence as to the acceptability of this contribution was received from all parties concerned, *viz.*, the superintendent, the teacher, expert visitors, parents and, by no means least significant, the pupils themselves in the form of spontaneous letters. Two indirect results deserve special mention. The pupils discussed the lessons with their parents (some of whom, by the way, had themselves been my university students); so far from interfering with other work, the interest aroused by the object lessons in physiology was reflected upon totally different branches of study, a point worth considering by those who apprehend that there is no room for science teaching in the public schools.

Appendix: Some educators are concerned as to what shall replace the classics in the curriculums where they are no longer required.* Why not neurology? It is certainly difficult enough, and for most persons —beyond a certain point—it would be quite as attractive and useful. Incidentally, too, there would be learned a by no means insignificant amount of Latin and Greek. This proposition should form the subject of a separate article, but in passing I desire to record publicly the cŏnviction that has been frequently expressed to my colleagues during my twenty-nine years of service, viz., that a certain minimum of both Latin and Greek should constitute a part of the intel-

* Under all the circumstances it seemed best to waive my personal preference for *myel*.

*See, for example, the article, 'After Latin and Greek, what?' in (Boston) *Journal of Education*, XLV., p. 196, March 25, 1897.

lectual equipment of every college graduate; not as entitling him to the name of classical scholar, but as enabling him to comprehend his mother tongue and use it to better advantage, and as facilitating the acquisition of scientific terminology.* That minimum should certainly not be less than what, at my suggestion, has long been required for admission to the two years' course preparatory to the study of medicine at Cornell University, *viz.*, the equivalent of four books of Cæsar's 'Gallic War' and of Goodell's 'The Greek in English.'

BURT G. WILDER.

* Linguistic errors may not vitiate anatomic knowledge, but such inaccuracies as *plexi* as a plural of *plexus*, and *pontic*, *pontine* or *pontal* as the adjective from *pons*, tend to arouse in classical scholars a general distrust of their perpetrators.

THE NATIVE DAHLIAS OF MEXICO.

THE *Dahlia*, botanically speaking, is purely an American genus confined to Mexico. When the Spaniards first visited Mexico they found a people who had advanced considerably out of the state of barbarism. Not only did these people have well-governed towns, but they were agriculturists and horticulturists. They cultivated fruits and vegetables, and in their gardens were many handsome flowers transplanted from the native soil. The Dahlia seems to have been one of these plants. So struck was he by the beauty of this flower that Hernandez, who visited Mexico in 1615, in his History of Mexico, published in 1651, makes mention of two species, one with pale red flowers which grew in the mountains of Quanhuahuac, and was called by the natives *acoctli*. A little over a century later, M. Thierry Menonville, a well-known French botanist of his time, was sent to Mexico by his government to steal the cochineal insect from the Spaniards. While on his dangerous mission Menonville saw the Dahlia on several occasions, and on his return to France, in 1787, published a book of his adventures, in which he spoke of the beauty of the strange flower which he had seen.

About 1788 some seeds of the Dahlia must have been sent to Madrid, for it is recorded that plants flowered for the first time in the botanic gardens of that city in October, 1789. A few of these seeds were secured by Lord Bute and sent to England, where they flowered in 1790. The plants, however, were soon lost, owing to the mistaken idea that they required stove treatment. About this time this species received the name of *Dahlia coccinea*, the generic name being given by Cavanilles, a Spanish priest and one of the most eminent botanists of his day, who was at that time the head of the Royal Gardens at Madrid. The genus was named in 1791 in the Icones Plantarum by Cavanilles in honor of Andreas Dahl, a Swede, a student and disciple of the great botanist Linnæus. Later, Carl Wildenow, objecting to the name *Dahlia*, on account of its similarity to *Dalea*, renamed the plant *Georgina* after Georgi, a Russian scientist and traveller. According to Salisbury, a second species, *Dahlia variabilis*, was introduced into England in 1804 by Lady Holland, who sent the seeds from Madrid. Its behavior under cultivation is described by Salisbury in his paper read before the Horticultural Society in 1808 and printed in the first volume of the Transactions.

The most successful early cultivator of the Dahlia appears to have been Count Lilieur at St. Cloud. He had four distinct varieties to work on in 1808. The experiments of the florists began in 1813, and a writer in a horticultural magazine of 1818 says that with each new year came new varieties until the kinds seemed almost like new creations, so different were they in color and form. Count Lilieur several years before had purples, dark reds, cherry-reds, buffs and

even pale yellow flowers. In 1850 the Dahlia appears to have reached the height of its popularity, after which date it began to decline until the year 1870, when the Dahlia Society founded in that year brought about a revival of interest in the plant. In 1872 additional interest was aroused in the Dahlia by the introduction of *Dahlia Juarezii*, the Cactus Dahlia said to have been obtained from Mexico by a Dutch nurseryman, Donkelaar. The organization of the American Dahlia Society within the last two years has added much to the re-awakened interest in the plant.

As early as 1841 one English dealer had over twelve hundred varieties. This shows the wonderful variability of the plant, which had been in cultivation practically only twenty-seven years. This, however, is not surprising, when we take into consideration the range of variation of the plant in a state of nature. While visiting the Valley of Mexico last summer the writer had the opportunity, as well as the privilege, of botanizing with the veteran botanist and collector, Mr. C. G. Pringle. The slopes of the southern range of mountains known as the Sierra de Ajusco were visited. The Dahlias were found growing in the greatest profusion on the lava beds, known locally as the Pedrigal, literally the Stony Place. Acres and acres of the Pedrigal in the latter part of August are one mass of color of the most varied hues and shades. As the train of the Mexico, Cuernavaca and Pacific Railroad carries you up from Contreras, at the foot of the Sierra de Ajusco, toward the top, where the Valley of Mexico lies spread out before you as a most pleasing panorama, you are carried up through woods that are a wild Dahlia garden—masses and masses of flaming blooms of three species of *Dahlia* in many distinct colors. Here are associated within a small area many beautiful plants with showy flowers, Bouvardias, Senecios, Stevias and the three species of *Dahlia*, viz: *Dahlia coccinea*, *Dahlia variabilis* and *Dahlia Merckii*.

Dahlia coccinea, *Dahlia variabilis* and *Dahlia Merckii* are three of the most common and best known Dahlias which grow in Mexico. Of these *Dahlia coccinea* has the more northerly and by far the most extensive distribution. From the Cordilleras of Chihuahua, within 200 miles of the United States boundary, it ranges southward through the mountains to Jalisco and the Valley of Mexico.* *Dahlia variabilis* is confined to the region around, including the Valley of Mexico. It is a most striking plant, growing from 5 to 6 feet tall, and bearing flowers ranging in color from purple to sulphur-yellow through the following gradations: lavender-purple, heliotrope, heliotrope-yellow (various shades of lighter and lighter hue approaching yellow) sulphur-yellow. The heads of which the ray florets are colored heliotrope-yellow are in reality of an heliotrope color, the bases of the ligulate corolla being of a yellow color shading off into heliotrope. They are broad (1 inch), long (2 inches) and ovate spatulate.

Likewise, *Dahlia coccinea* shows a remarkable variation in color from cardinal of several shades through scarlet, scarlet-orange, mandarin, orange, lemon-yellow, yellow.† The so-called scarlet-orange rays are scarlet with lines of yellow running through, so that the strap-shaped corolla has a somewhat banded appearance. The ligulate corolla is about an inch long and half an inch broad. The entire head varies in size from two inches in the cardinal ones to three inches in the scarlet-orange ones.

Dahlia Merckii runs from purple to pure white through the gradual fading-out of the

*1891, Pringle, *Garden and Forest*, IV., 40.

† These colors have been compared with the colored silk samples issued by Belding & Co. and the Maryland Silk Company, Hagerstown, Md.

purple color. One most commonly sees in a state of nature the white heads which are tinted with lavender or pale purple at the base of the ray floret. The heads in each case are nearly uniform in size, being about an inch and three-fourths across.

There are several other species worthy of mention. *Dahlia imperialis*, *D. scapigera*, *D. dissecta* and *D. pubescens*. *Dahlia dissecta* was discovered by Mr. C. G. Pringle growing on limestone ledges fifty miles east of San Luis Potosi. "It is a very unique species, being scarcely more than two feet high and of bushy habit from an almost woody base." The flower heads are two or three inches broad, with about eight mauve colored rays. *Dahlia pubescens* was found by the same botanist on calcareous bluffs of prairies bordering the valleys of small streams in the State of Mexico and to the north of Toluca. It is a small plant, one and a-half to two feet high, with heads two to three inches broad, with a yellow disc surrounded by eight rays which are purple, with lines of deeper color which changes with age to light purple or dull rose.

The tubers of these plants, particularly those growing on the lava beds along the southern mountainous rim of the Valley of Mexico, are hard to obtain, because of the depth to which they sink in the lava pockets. All of the species store up in their tubers a substance called inulin, chemically allied to starch. The substance is in solution in the cell, much as sugar is, but crystallizes out in needle-shaped crystals upon the addition of alcohol. This substance is stored up as a reserve food to meet the demands of the plant during the active growing season, and the tubers with this stored substance perpetuate the species during the long droughts which are frequent in Mexico.

The dry season in the region of the Valley of Mexico lasts from about the first of October until about the first of June, when there are signs of the returning rainy season. During the drought the tubers of the Dahlias lie dormant until the first rain moistens the soil, when they spring up in great numbers everywhere on the lava beds. The plants grow vegetatively until the end of August, when they flower in the greatest profusion. The rainy season is characterized in the Valley of Mexico by afternoon thunder showers. The morning will be cool, and the air bracing, until evening, when the sky becomes overcast and the rain comes down sometimes in torrents.

A consideration of these meteorological conditions ought to influence the cultivation of the Dahlia, which has not been entirely understood. It will repay some energetic nurseryman to obtain fresh tubers directly from the mountains of Mexico by a personal visit to the native home of the plant. It will repay him to collect tubers of every plant with a different shade of color. As already intimated, the plants in a state of nature are extremely variable. This variation in nature, as compared with the variation produced by cultivation, is just as striking, and shows us that many of the species are in an extremely unstable state of equilibrium as regards their plasticity. This great plasticity in a state of nature explains how so many new colors and forms originated, almost as if by magic, when the Dahlia was first introduced into cultivation. The inherent possibilities of color and form were represented in the protoplasm, and only needed the stimulus of a varied culture to bring out these latent acquired characteristics.

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CURRENT NOTES ON ANTHROPOLOGY.

INSCRIPTION OF THE CROSS AT PALENQUE.

THIS most famous of all the Mayan inscriptions has been subjected to a searching analysis by Dr. Förstemann (in *Globus*, Vol.

72, No. 3). He reads it in the direction advocated by Rau, beginning at the left upper corner, and confirms Rau's opinion that it is a chronological record. The very large glyph which in this plan comes first he states is a compound of the three glyphs used for the highest customary time-periods of the Mayas, — 360, 7,200 and 144,000 days, and is to be understood as signifying 'time-counter,' or 'historical table.'

The inscription itself is made up of a series of glyphs representing dates; between these is another series representing spaces of time, and a third class of unknown meaning, perhaps historic facts. If the latter, the glyphs would read like the following:

"March 4, 1893; Cleveland, President; 4 years; March 4, 1897."

Or it may be that not historic data, but religious notions are intended, such as the supposed control of a certain period of time by a certain divinity, etc. At any rate, this scheme of the inscription, whatever its application, seems to be well established by this learned and thoughtful article by the most erudite student of the subject living.

THE ETHNOLOGY OF KISSING.

THE kiss was unknown, I think, among the aboriginal tribes of America and of Central Africa. From the most ancient times, however, it has been familiar to the Asiatic and European races. The Latins divided it into three forms—the *osculum*, the *basium* and the *suavium*; the first being the kiss of friendship and respect, the second of ceremony and the third of love. The Semites always knew the kiss, and Job speaks of it as part of the sacred rites, as it is to-day in the Roman Church.

The Mongolian kiss, however, is not the same as that which prevails with us. In it the lips do not touch the surface of the person kissed. The nose is brought into light contact with the cheek, forehead or hand; the breath is drawn slowly through the nostrils, and the act ends with a slight smack of the lips. The Chinese consider our mode of kissing full of coarse suggestiveness, and our writers regard their method with equal disdain.

Darwin and other naturalists have attempted to trace back the kiss to the act of the lower animals who seize their prey with their teeth, etc. An interesting recent study of the subject is by M. Paul d'Enjoy, in the *Bulletin* of the Paris Anthropological Society, Vol. VIII., No, 2.

THE ABORIGINES OF INDIA.

Two articles on the Dravidian stock of Hindostan have recently appeared. One is by Professor Oppert, in Nos. 4 and 5 of *Globus* (Bd. 72); the other by Dr. Zaborowski in the *Bulletin* of the Anthropological Society of Paris (1897, fasc. 2).

Professor Oppert refers to the Aryan invasion of India, and the profound differences between the two stocks which have been maintained by the caste system until the present day. He points out in detail the sharp contrasts in the morphology of the Dravidian and Ayran linguistic stocks, describing the former as concrete, the latter as abstract in its conceptions. Without directly connecting the Dravidian with the Ural-Altaic group, he draws attention to certain similarities between them.

Dr. Zaborowski reviews the recent ethnographical literature of the subject, and argues that the Dravidians of southern India descend from the same family as the Mois of Cochin China and the Malayan tribes of the island world. He supports this from somatic traits, coincidences of customs and religions, and partially from linguistic research. While his article does not carry conviction, it is a result of a careful study of the question.

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SCIENTIFIC NOTES AND NEWS.

THE ROYAL SOCIETY.

THE ROYAL SOCIETY held its anniversary meeting at the Burlington House on the afternoon of November 30th and its anniversary dinner on the evening of the same day. The medals were presented in accordance with the announcement already made, and the officers were re-elected, with the exception of some members of the Council. The officers elected are as follows: President, Lord Lister; Treasurer, Sir John Evans; Secretaries, Professor Michael Foster, Professor Arthur William Rücker; Foreign Secretary, Sir Edward Frankland; other members of the Council, Professor William Grylls Adams, Professor Thomas Clifford Allbutt, Sir Robert Stawell Ball, Rev. Thomas George Bonney, Professor John Cleland, Professor Robert Bellamy Clifton, Professor James Alfred Ewing, Alfred Bray Kempe, John Newport Langley, Joseph Larmor, Professor Nevil Story Maskelyne, Professor Raphael Meldola, Professor Edward Bagnall Poulton, William James Russell, Dukinfield Henry Scott, Professor Walter Frank Raphael Weldon.

Lord Lister delivered the anniversary address, beginning by enumerating the fellows and foreign members who had died during the year, and paying a tribute to those whose scientific services had been the most noteworthy, including Sylvester, Sir Augustus Wollaston Franks, the Rev. Dr. Houghton, Edward Ballard, James Heywood, Weierstrass, DesCloizeaux, Julius von Sachs and du Bois-Reymond.

Lord Lister then proceeded to report on the activities of the Royal Society during the year, including the address of congratulation presented to the Queen, the deputation of the Society to urge upon the government the establishment of a National Physical Laboratory, and its relations with the India office in regard to the treatment of the plague. Lord Lister further referred to Dr. Copeland's researches on variola and vaccinia and to the contributions collected by the Society for the National Pasteur Memorial. At the anniversary dinner toasts were proposed or responded to by the President, Sir John Evans, the Duke of Devonshire, the American Ambassador, Professor Forsyth, Lord Kelvin and Professor Campbell.

THE NEW YORK STATE SCIENCE TEACHERS' ASSOCIATION.

THIS Association will, as we have already announced, hold its second annual meeting at Ithaca on December 30th and 31st, following the sessions of the American Society of Naturalists and the affiliated societies. The objects of such an Association should commend themselves to all men of science, and it is hoped that as many as possible attending the other meetings will remain at Ithaca over Thursday and Friday, and that all resident in New York State will join the Association. The program arranged for the meeting is as follows:

Thursday afternoon at 3 p. m., address of welcome by President J. G. Schurman; paper by Miss Mary E. Dann, of the Girls' High School, Brooklyn, on 'Physical Laboratory Work in Secondary Schools.' Discussion opened by Professor John F. Woodhull, Teachers' College, New York; followed by Professor D. L. Bardwell, Cortland Normal School, and Professor Irving P. Bishop, of Buffalo Normal School.

At the evening session, in the Physical Lecture Room, an address will be given by the President of the Association, Professor Nichols, on 'The Use of the Lantern in Science Teaching' (illustrated by numerous experiments). After the evening session there will be an informal reception at the house of the President.

On Friday morning the report of the committee of nine will be presented on the three following subjects: (1) The recognition of science as a requirement for entrance to Colleges. (2) Science courses for secondary schools. (3) Nature study in elementary schools. A paper by Professor L. M. Underwood, of Columbia University, on 'The Teaching of Botany in Secondary Schools,' will be followed by a discussion by Miss Sarah V. Chollar, of Potsdam Normal School, and Professor W. H. Lennon, of Brockport Normal School.

In the afternoon there will be round tables for the discussion of science teaching, as follows: I. 'Union Schools and Academies,' led by Principal Thomas B. Lovell, of Niagara Falls High School. II. 'Normal Schools,' led by Professor Howard Lyon, of Oneonta Normal School. III. 'Colleges,' led by Professor B.

G. Wilder, of Cornell University. The final paper will be on 'Out-door Science Work in Secondary Schools,' by Principal Frederick A. Vogt, of Buffalo Central High School. Discussion opened by Professor A. D. Morrill, of Hamilton College, Clinton; followed by Professor Chas. B. Scott, of Oswego Normal School, and Professor R. A. Surface, of Cornell University.

A NATIONAL DEPARTMENT OF HEALTH.

THE New York Board of Trade and Transportation has addressed a circular letter on public health and quarantine to the Governors of States, to the Mayors of all important cities, seaboard and interior, and to all State and municipal health authorities, physicians, and known experts on the subject, asking for opinions as to the desirability of creating a national department of health, and requesting suggestions as to the best method of protecting the public health, especially as the same affects interstate commerce, on the following lines:

(1) Quarantine status and administration in foreign countries as furnishing precedents for the United States. A, border; B, internal.

(2) The present status of quarantine in the United States. A, border defence; B, interstate; C, state and local.

(3) The existing system of quarantine administration in the United States. A, cost; B, injury to and restrictions imposed on commerce and travel; C, security afforded.

(4) Legislation needed for lessening injury to and restrictions on commerce and travel, and to afford greater security to the country. A, increase power of Marine Hospital Service and how; or, B, create a national department of health; or, C, create a national department of commerce, with a bureau of health; or, D, other suggestions.

(5) The power of Congress under the Constitution to regulate matters affecting the health of the people. A, national; B, interstate; C, State and local.

THE PROTECTION OF THE SEA OTTER.

THE Treasury Department has recently issued an important and interesting 'Report on the Sea Otter,' by Capt. C. L. Hooper, of the revenue marine, giving an account of its range, habits, method of capture and decrease under American rule almost to the point of extermination. From 1873 to 1883 the annual catch increased from 2,265 to 4,152, and then, as the inevitable result of overhunting, rapidly declined, the catch for 1896 being only 724. So sharp has been the pursuit of this valuable animal that it has changed its habits, no longer coming on shore to feed, rest, or bring forth its young. As about 1,200 natives of the Aleutian Islands are almost wholly dependent on the sea otter for the necessaries of life, it is highly important to make some effort to preserve it, and to do so promptly. With this end in view, a set of regulations for 1898 are appended, intended to preserve the remaining sea otters for the use of the Aleut hunters and their families, in accordance with the spirit of article 1,956, Revised Statutes. The Report is accompanied by a map showing the sea otter grounds, which lie mainly to the southwest of Kadiak and in waters considered to be within the jurisdiction of the United States. If so, the proposed regulations, properly enforced, will furnish ample protection; if not, an international agreement would be necessary and a limit of fifteen miles from shore. The remaining otter would then be protected, and hunting from schooners being prohibited, the natives would be compelled to hunt from the shore, and the otter would have some chance of increasing.

GENERAL.

WE record with regret the death of the Hon. Gardiner Greene Hubbard, at his residence near Washington, on December 11th, in his 76th year. He was President of the National Geographic Society, whose great success was almost entirely due to his efforts, and was prominent in all movements for the advancement of science at Washington. The first series of this JOURNAL was greatly indebted to him for his counsel and financial support, it having been established by him and Professor A. Graham Bell.

A BUST of Pasteur was unveiled on November 28th at Melun as a memorial of his anti-anthrax vaccine. On the same day a memorial to him was also unveiled at Boulogne, an address being made by M. Gaston, Paris.

AT the anniversary meeting of the Royal Society Lord Lister announced that Sir William Mackinnon, late Director-General of the Med-

ical Department of the Army, had, by will and codicils dated 1896 and 1897, after making certain specific legacies, including one of £2,000 to the University of Glasgow, bequeathed the whole residue of his property to the Royal Society, subject to certain life annuities. The proceeds of the fund were to be applied by the Royal Society for the foundation of such prizes and scholarships for the special purpose of furthering natural and physical science, including geology and astronomy, and for furthering original research and investigation in pathology, as the Society might think best and most conducive to the promotion of those sciences and of original discoveries therein; such prizes and scholarships to be called after the name of the testator.

THE Berlin Academy of Sciences has made a further appropriation of 3,000 M. for the History of the Academy now being prepared by Professor A. Harnack.

E. CZABAN, a Warsaw merchant, has bequeathed 50,000 roubles (some $35,000) to the Warsaw Academy of Sciences and also 30,000 roubles to both the University of Cracow and the University of Lemburg.

THE Indiana Academy of Science will hold its annual meeting at Indianapolis on December 28th, 29th and 30th, under the presidency of Professor Thomas Grey, Terre Haute, Ind.

THE Lick Observatory eclipse expedition, from San Francisco, has arrived at Bombay and will proceed inland to select an observing station.

IT is reported that an endeavor will be made to found an astronomical observatory at Glasgow.

THE Marine Biological Station of the University of Tokyo, at Mazaki, will be removed during the present year to a new site about two miles north of the present location. A proposed railway will bring the station within two or three hours of Tokyo.

A MARBLE bust in memory of the geologist A. Stelzner has been unveiled in the School of Mines at Freiburg.

IT is proposed to commemorate the late Mr. J. Greig Smith, M.A., M.B., C.M., Aberdeen, professor of surgery at University College, Bristol, by erecting within the precincts of the University of Aberdeen a memorial tablet.

DR. CAMPBELL MORFIT, the chemist, died on December 8th in London. He was born in Herculaneum, Mo., November 19, 1820. He was formerly professor of applied chemistry in the University of Maryland. In 1858 he removed to New York, where he followed his profession until 1861, when he went to London.

THE death is announced of Mr. Ernest Giles, the Australian explorer, who between 1874 and 1875 twice traversed the West Australian desert from Adelaide to Perth. The Royal Geographical Society awarded him its founder's medal for his journey.

BILLS have been introduced in both branches of Congress prohibiting pelagic sealing by citizens of the United States.

SECRETARY LONG has issued an order transferring the Naval Hydrographic Office from the control of the Navigation Bureau to the Bureau of Equipment. The latter bureau now has charge of the Naval Observatory and similar branches of the service.

ONE hundred employees of the Gypsy Moth Commission have been discharged, the appropriation made by the Legislature being nearly exhausted.

LIEUTENANT R. E. PEARY, having again complained in London of Captain Sverdrup's unfairness in going to Smith Sound next summer, Captain Sverdrup explains that he wrote to Mr. Peary some time ago saying that he did not aim to reach the pole, but only intended to explore Greenland and to make a study of the ice.

THE Zurich correspondent of the London *Times* writes that at Windisch the old Roman colony of Vindonissa, in the Canton of Argovie, excavations recently carried out under the auspices of the Swiss Archæological Society have yielded important results. Large Roman villas and an amphitheatre have been disinterred and, besides a large quantity of coins, pottery, bronze and ironware, some large silver vessels have been discovered, which are said only to have their equals in the famous treasure-trove

of Hildesheim, in Germany, brought to light in 1868.

THE daily papers report that uranium has been discovered near Black Hawk, Col. The mineral is worth $1,500 per ton, and the agents of a French syndicate have announced that they will buy all that can be produced, as it is much desired by the French government for hardening and solidifying gun metal and armor plate.

THE American Forestry Association held its 16th annual meeting at Washington on December 8th. General Francis H. Appleton, of Boston, presided and made an address. The chairman of the Executive Committee, Dr. E. B. Fernow, presented a detailed report, reviewing especially the legislation of the past session of Congress. The Association proposes to establish a monthly journal, *The Forester*, devoted to the interests which the Association is doing so much to forward. The summer meeting of the Association will probably be held at Boston, in conjunction with the American Association for the Advancement of Science.

THE British Institution of Electrical Engineers, which now numbers 3,000 members, held its annual dinner on November 24th. Addresses were made by Lord Kelvin and others.

IT is expected that the life of Pasteur by his son-in-law, M. Vallery Radot, will soon be ready for publication.

M. ALCAN announces, in the next volume of the French edition of the 'International Scientific Series,' a work on the physiology of hearing by Dr. Gelle.

THE *Open Court* continues in the December number the series of portraits of mathematicians, with the reproduction of an old steel engraving of Lagrange, of whom Dr. T. J. McCormack gives a biographical sketch.

AT the anniversary dinner of the Royal Society on November 30th Lord Kelvin referred to the presence of representatives of many foreign powers and of the Ambassador of the United States, who, he said, 'could not be regarded as a representative of a foreign nation.' In his address at the dinner Lord Lister remarked: "That among the great number of eminent Americans who attended the Canadian meetings of the British Association and the Medical Congress there was never a jarring note; there was never anything but cordiality and kindly feeling towards the old country."

MAJOR M. P. HANDY, special commissioner to gather information regarding the Paris Exposition of 1890, recommended the appropriation of $915,000 towards the expenses of preparing a proper representation for the United States. The sum includes $1,500 per year for three years for each of nine scientific experts. In his report Major Handy says: "The industrial progress of the United States, and the evolution of its material resources during the hundred years which the Exposition is to crown, has been unequalled by that of any other nation. It is not too much to say that the United States now stands the greatest nation of the world in all the great lines of industry. According to the figures given by the eminent statistician Mulhall in his 'Industries and Wealth of Nations,' the United States leads in agriculture, with products greater than Russia and the United Kingdom combined; in the manufactures with a product of greater value than the aggregate output of the factories of the United Kingdom, France, Austria-Hungary and Belgium combined; in machinery with a greater steam power than the United Kingdom, Austria-Hungary and Italy combined; in mining with a product greater than the United Kingdom and France combined, or nearly one-third of that of the entire world; in railway transportation with a mileage 40 per cent. greater than that of all Europe; in forestry with products greater than that of all Europe, and nearly one-half of the total products of the world; in fisheries with a greater product than the United Kingdom, Russia and Germany combined."

THE English papers report that the Guilford Natural History Society have been considering the question of the preservation of Wolmer Forest, which is only fifteen miles from that town, and have decided to present a petition to the Commissioners of Woods and Forests, praying that Wolmer Forest may be reserved as a sanctuary for wild birds, in which they, their nests and eggs may remain unmolested

throughout the year; that it may not be let at any time for game preserving, or for any purpose inimical to bird life; and that it may remain in perpetuity as a national memorial to the greatest outdoor naturalist England has produced—Gilbert White, of Selborne. Such a recognition, the Society urge, would show that the admiration of Gilbert White in the nineteenth century was so practical as to be of value to the naturalist and the English-speaking race for all succeeding time. The Society have no wish to attempt to interfere with the use of the Forest by the War Office for the purposes of military manœuvres.

UNIVERSITY AND EDUCATIONAL NEWS.

BILLS have been again introduced into both Houses of Congress to establish the University of the United States. Such a bill was introduced by Senator Edmunds in 1890 and referred to a select committee, which reported unanimously in its favor. The standing committee since appointed has also reported unanimously in its favor and it is said that the bill will probably be passed during the present session.

NEGOTIATIONS are said to be under way looking towards the affiliation of the University of Chicago and the Rush Medical College.

EVELYN COLLEGE, Princeton, has been closed, owing to the fact, as stated by the principal, that Princeton University refuses to recognize any work for the education of women.

MR. FRANZ KEMPE, of Stockholm, has given the University of Upsala the sum of about $45,000 for the establishment of an associate professorship of physiological botany under the condition that Dr. Lundström be the first incumbent.

BY the will of the late F. Ulrich the German University of Prague receives 100,000Fl. for the distribution of scholarships.

A PROPOSITION has been introduced into the French Chamber and referred to the Education Commission creating a chair of colonial science in the University of Paris.

PROFESSOR WALDEMAR LINDGREN, of the U. S. Geological Survey, has been appointed to the chair of metallurgy and mining engineering in Stanford University.

MR. EDGAR R. CUMINGS, of Cornell University, who graduated from Union College last June with honors in geology, has been appointed instructor in geology in the University of Indiana.

DR. W. OPHÜLS, assistant in the University of Göttingen, has been called to the chair of pathological anatomy in the University of Missouri.

DR. S. FUCHS has been promoted to an associate professorship of physiology at the University at Jena.

THE regents of the University of the State of New York have just published as bulletin 38 a compilation of all the laws, ordinances and by-laws pertaining to higher education in this State. It includes not only the University law, but also the educational articles from the Constitution and the various statutes governing professional education and license to practice, and other allied matters. Its practical utility is greatly increased by many annotations and cross references and by a very full index, so that every lawyer or school officer will find it indispensable when considering any of the large class of questions covered. It is being sent to every institution in the University free, but lawyers or others interested may obtain copies from the regent's office, post free, at the nominal price of 15 cents for the 108 pages.

THE report of the Sites Syndicate of Cambridge University was approved on November 25th. By it provision was made for sites for the erection of a law school, for new buildings for the department of botany, for a museum of general and local archæology and of ethnology, to be erected on ground purchased from Downing College. The mathematical professors are to be provided for by buildings to be erected on the site purchased from Messrs. Murtlock & Co., while the rooms now occupied by them are to be assigned, together with the bird room, when vacated, to the department of morphology. The rooms between the bird room and the department of physiology are to be assigned to the departments of physiology and morphology. The present Geological Museum in Cockerell's buildings and the rooms in Scott's buildings occupied by the University for business pur-

poses are to be appropriated to the University library as soon as they can be vacated. The site now occupied by the old Anatomical School, part of the pathological department and a portion of the unoccupied part in Downing street is to be reserved for the erection of new buildings for the medical, surgical and pathological departments.

DISCUSSION AND CORRESPONDENCE.

THE UNITED STATES FISH COMMISSION.

THE recent editorial of SCIENCE on the subject of the United States Fish Commission is unfortunately misleading in some of its statements, and, in justice not only to the Commissioner but to the entire personnel of the Commission, these should be corrected.

While the amount of scientific work accomplished under the direction of the Commission may not be as great as men of science might wish, it must be remembered that, after all, the primary object of the Commission is to preserve and increase the fisheries, and, so far as this can be accomplished by artificial propagation, this has been done. Moreover, it should be borne in mind that, aside from salaries, the sum to be expended in any one branch is determined by the appropriation committee, and the appropriation for 1898 contained $132,000 for the propagation of food fishes and but $10,500 for scientific research.

A comparison of the annual reports for a few years back will show that it is hardly just to say that 'the efficiency of the hatcheries and of methods of distribution cannot be advanced or even maintained.' In regard to the oyster the work of Dr. J. A. Ryder and others under the Fish Commission is well known, and it may be said that the investigations of the past two years compare favorably with those of previous years, and that important reports on the subject have been published.

In regard to the lobster it is hardly correct to say that 'we are not told how many eggs are killed at the hatcheries,' when the report of the Commissioner definitely says that '128,000,000 eggs were secured, producing 115,000,000 fry.' The rest of the matter is unjust because, as in the case of shad, the eggs were *all* obtained from animals taken for market, and had they not been purchased by the Fish Commission the eggs would have been a total loss to mankind, and the adult lobster would have been killed instead of being returned to the water. While the sale of 'berried lobsters' is prohibited by law, very little regard is paid to the statute, as it is an easy matter to scrape off the eggs and sell the females without running the least risk. Instead of the work being analogous to 'taking all the babies born in New York City and depositing them in a baby farm,' it is like rescuing them from 'baby farms' and worse, and transferring them to a municipal orphan asylum.

That the Commissioner of Fisheries should have a practical and scientific knowledge of fishes is undeniable, but meanwhile let us at least be just to the present one. F. A. L.

[CERTAINLY the Fish Commission should be given its due. It is, as we stated in the article referred to, doing a useful work in the distribution of fry, but does F. A. L. really believe that this can be done in the most satisfactory manner under the direction of one ignorant of the life-history, habits and natural environment of fishes? What does F. A. L. regard as the probable outcome, should all the scientific departments, bureaus and surveys at Washington be placed under the charge of professional politicians and their relatives and supporters? Dishonesty would soon follow inefficiency, and the present condition of the Fish Commission, bad as it is, would be looked back to as relatively ideal. In mentioning Ryder our correspondent calls attention to work of the kind that the Commission is no longer able to carry out. If we differ from F. A. L. as to the efficiency with which the lobster is propagated, is the present Commissioner competent to decide who is right? We have no wish to suppress discussion in this JOURNAL, but it is unfortunate if men of science cannot unite in maintaining principles on which depend the scientific and economic work under the government.—ED. SCIENCE.]

A NATIONAL DEPARTMENT OF HEALTH.

TO THE EDITOR OF SCIENCE—In the excellent article on 'The Progress and Achievements of Hygiene,' in your issue for November 26th, there is an error of omission which, whether intentional or not, should not be allowed to pass uncorrected in a journal so prominent as SCIENCE.'

On page 796 the writer says: "Since Congress has failed to act upon the President's repeated recommendation and the petitions of numerous medical societies for the creation of a National Health establishment, there is no good reason why the scope of duties and powers exercised by the Marine Hospital Service should not be enlarged;" making no allusion, whatever, to the comprehensive bill recently drawn up by the American Medical Association, to be urged before the present session of Congress.

The bill, as formulated, provides for an independent department, of which the Marine Hospital Service shall constitute, as it should, a subordinate bureau.

The conservation of the public health, considered even from a purely economical standpoint, is of national importance and should be relegated to no subordinate bureau with or without 'an advisory board.' To do so would be to postpone, perhaps for decades, the imperative and rational step which should be taken now.

The head of the new department ought to be made a cabinet adviser, but perhaps this may not be at present. If necessary, the Constitution can and will in time be altered to give it additional powers consonant with the requirements of modern sanitary science. To quote Dr. Girdner in the *North American Review* for the present month, what is needed is: "A unifying and supervising force in the national government which will direct, harmonize and render efficient the agencies of the various States."

C. H. PRESTON.

DAVENPORT, December 7, 1897.

SCIENTIFIC LITERATURE.

Habit and Instinct. By C. LLOYD MORGAN. London, Edward Arnold. 1896. 8vo. Pp. 352.

This is a work on comparative psychology largely based on observations of bird life, and containing appropriate speculations concerning the origin and development of certain mental phenomena. The press work is excellent, the one illustration fair and the binding poor.

In the preface Professor Morgan makes a gracious allusion to those whom he met during his lecture tour, and he shows throughout the entire book an appreciation of, and a remarkable familiarity with, the work of American biologists. This may be due to the fact that 'Habit and Instinct' is the embodiment, in book form, of a series of lectures delivered in various university centers of the United States; but one experiences an exhilarating sensation of novelty in reading a book on modern biological problems which is neither supported by the legs of Lord Morton's mare nor infested with bob-tailed mice and epileptic guinea pigs.

First, defining his use of such terms as habit, instinct, reflex action, connate and deferred activities, automatism, etc., he divides the animal activities into those which are inherited and those which are acquired. From the biological point of view, habits are acquired activities of the individual, while instincts are congenital activities not characteristic of the individual alone, but of all the members of the group to which the individual belongs.

The first third of the book is largely descriptive of the habits of young birds and mammals, the birds in particular being selected from representative groups. The anecdotes are told in a most entertaining manner, but one fears that, as the embryologist drew many false conclusions from data supplied by the highly specialized meroblastic egg of the hen, so the comparative psychologist may be deceived by the data furnished by the highly specialized mental equipment of the bird. Though the observations would doubtless prove less entertaining, it is in the lower rather than in the higher vertebrates that one would search for the more simple and less involved mental phenomena. The anecdotes are generally pertinent, but a half page of speculation as to how a pig would jump out of a chair is neither instructive nor conclusive.

Having arranged his data, Professor Morgan really begins his work in the sixth chapter,

where he maintains that the first instinctive act (for example, the first peck of a newly hatched chick), the more automatic result of an inherited motor coordination, supplies to consciousness its first experience-data. "This is due to complex groups of incoming currents, from the parts concerned in the response, along afferent nerves to the sensorium." On this first occasion the consciousness arises wholly by back-stroke. "On subsequent occasions, under associative suggestion, revivals in consciousness of previous experience-data modify the whole process and introduce the effective guidance of consciousness," * * and * * "This profiting by individual experience is of the very essence of intelligence."

If the revivals in consciousness are pleasurable the activity is augmented; if unpleasant or painful it is inhibited. The repetition of the act becomes, then, a matter of conscious choice, and through reiteration the action becomes ingrained and habitual. "On this conscious selection and choice depends * * * the development of those habits which are acquired as opposed to those which are congenital; and * * * the whole mental as contrasted with merely biological evolution."

In treating of imitation, while it is admitted that there may be imitative organic response, independent of experience, the incentive to intelligent imitation is the pleasurable sensation which the imitator receives when his acts resemble the acts of others. The tendency to imitate is thus based on an innate proclivity, and is the means of securing to the organism a congeries of acquisitions which, perfected through repetition, may finally become habitual. In the opinion of Professor Morgan, already expressed in an earlier work, the value to the organism of the imitative tendency is vital. On its presence the questions of survival or destruction frequently depend, for the imitation of the quick-witted and alert is often the salvation of the more stupid. In gregarious animals, through 'tradition,' acquisitions are handed down from generation to generation without the aid of hereditary transmission.

The motif in the chapter on 'Emotions' is the elaboration of the theory of James, namely, that the emotion originates, is primarily generated, by a back-stroke from the motor organs and viscera, and thus 'all the data of sense experience are of peripheral origin.' Though Morgan's observations appear to be in accord with this view, the reader may not feel thoroughly convinced that the emotions are universally the conscious effect of the back-stroke from the visceral actions.

In the succeeding chapter the author shows that though an emotion is private to, and exclusively for, the individual receiving the back-stroke, the subsequent 'expression' may be, and often is, an indication to others of the particular emotional state. "So long as the expression indicates an emotional condition which shows that the animal means business, that is enough from the biological point of view." He thus incidentally reconciles Wallace's theory of exuberant vitality with commonplace sexual selection. Exuberance of vitality may be expressed, on the one hand, by emotion (song, etc.), and, on the other, by peculiarities of structure (plumes, etc.). Both may be of varying potency in arousing the sexual instinct of the opposite sex, and thus of varying selective value. "Stripped of all of its unnecessary æsthetic surplusage, the hypothesis of sexual selection suggests that the accepted mate is the one that most strongly evokes the pairing instinct."

The view is advanced that the song of birds, unlike their calls and alarm notes, may be 'traditional' and due to imitation; and the question of the instinctive nature of the peculiar antics and aërial evolutions of certain birds, before and during the breeding season, is raised. But 'in all these matters further and fuller evidence from direct observation is to be desired.'

The sordid questions of domestic economy, nest-building, incubation, the care of young, etc., are now discussed and the questions raised: Are these phenomena instinctive or are they intelligent? Are they congenital or are they the result of individual experience? If instinctive, are they attributable to natural selection alone, or to the inheritance of acquired habit? So far as certain of the phenomena are concerned, the author favors a possible cooperation of natural and intelligent selection, though he concludes that as matters stand 'the ques-

tion must be left open.' Questions arising in connection with the migratory habit are left in a similar way.

Professor Morgan now lays special stress upon consciousness as a cooperating factor in organic development. In the earlier chapters it was assumed, for the sake of simplicity, that mental evolution might be concomitant with, rather than a factor of, organic evolution. His presentation of the difference between organic evolution as a result of the elimination of the unfit, and of organic evolution as a result of conscious choice, through the elevation of the fit, is extremely ingenious, and the part that the latter may play in the struggle for existence is clearly shown. "In so far as conscious adjustment aids in the struggle for existence, in so far through it the animal is better able to escape danger, to secure a more favorable habitat, to gain a mate and beget progeny; the animal possessed of intelligence will escape elimination, transmit his power of conscious adjustment, and contribute to the propagation of his race. Without fully subscribing to the doctrine of the all-sufficiency of natural selection, we may yet say that natural selection will exercise a determining influence in deciding the course which conscious adjustment must take."

The question of the inheritance of acquired habits is many times raised, but receives no partisan treatment in the first three hundred pages. In the latter part of the book the author instinctively holds to his earlier belief, while admitting, as a result of his experience, certain intelligent modifications of his views. We quote from page 305:

"If pressed to summarize my own opinion on this question, I should say: First, that there is but little satisfactory and convincing evidence in favor of transmission, but that variation does seem in some cases to have followed the lines of adaptive modification, so as to suggest some sort of connection between them; secondly, that there are many instincts relatively definite and stable which may fairly be regarded as directly due to natural selection, though here again, if we could accept the view that adaptive modification marked out the lines in which congenital variation should run, our conception of the process of their evolution would be so far simplified; thirdly, that there are some peculiar traits, also seemingly definite and stable, which can only be attributed to the indirect effects of natural selection."

In the discussion of *modifications* and *variations* the author follows Mark Baldwin in defining the former as acquisitions which occur in the course of individual life, and the latter as those changes in the individual which are the result of some disturbance in the germinal substance. Mental phenomena are laid aside for a time and the more easily apprehended arguments and illustrations from structure adopted. The author dwells at considerable length upon the claims of the extreme Neo-Darwinians, on the one hand, and the extreme Neo-Lamarckians, on the other, and concludes that "all this is very interesting, and affords considerable scope for ingenuity. But it does not touch the question at issue, and this is, not which method is apparently the most advantageous; not which method we should have adopted had the work of creation been entrusted to our care, but which has been adopted by nature." Weismann's principles of *germinal* and *intra-selection*, Baldwin's *organic selection* and the author's *innate plasticity* indicate the neutral ground where selectionists may meet transmissionists; where fortuitous variations may finally take the place of mere temporary adaptive modifications.

Professor Morgan's entertaining style, his originality of experiment, his quick interpretation, his rare quality of explanation and the comparative novelty of his subject will give 'Habit and Instinct' a place beside 'Animal Life and Intelligence' in the library of every working biologist. HERMON C. BUMPUS.

Das Nördliche Mittel-Amerika, nebst einen Ausflug nach den Hochland von Anahuac. Von DR. CARL SAPPER. Braunschweig, Vieweg und Sohn. 1897. With maps and illustrations. Pp. 436.

The studies of Central American geography and ethnography which Dr. Sapper has contributed to *Petermann's Mittheilungen*, *Globus* and other periodicals, from time to time during the last ten years, have made his name familiar to all interested in the products and history of that portion of our continent. In the volume

before us he has gathered many of these articles together, added others not heretofore published, and appended thirty pages of vocabularies of the native tongues, specimens of Indian music and various statistical matter (rainfall, culture products, etc.).

The descriptions of travel and of the manners of the present inhabitants are vivid and well told, but for scientific purposes the articles on the native population will have the higher interest. These embrace a discussion on the independent native States in Yucatan, the commercial relations of the Indian tribes in northern Central America, the present Indian geographical names in the same area, the ruins of aboriginal towns and fortresses there found, the music and dances of the existing tribes, and special articles on the Lacandons and Kekchis, two branches of the Maya family which Dr. Sapper had unusual opportunities to observe.

The information he gives on all these subjects is abundant and drawn from his own studies. Especially his article on the architectural principles indicated in the ancient ruins, and the connection of the culture areas which they indicate, is replete with new and instructive suggestions. It is amply illustrated by a number of designs in the text.

The maps are eight in number and show respectively the location of volcanoes, the distribution of vegetation forms, the elevation of land, the cultivation of commercial plants, the extension of languages, the independent Indian tribes, the native names and the ancient ruins of northern Central America.

In the final paper of the volume the author ventures on the important question as to the original seat of the Mayan culture and language. He gives substantial reasons for saying it was *not* Yucatan, which peninsula he thinks was first occupied by the Mayas about the fifth century of our era; nor was it Guatemala, Tabasco, or the territory of the Huastecas, north of Vera Cruz; but most likely the highlands of Chiapas (in which he agrees with Dr. Schellhas). He considers the adoption by the Mayas of a sedentary and agricultural life to date from a remote antiquity, and conclusively disproves the prevalent notion that it was originated or deeply modified by either 'Toltecs' or Nahuas.

The extended vocabularies include a large number of 'culture words' from the Mayan dialects, and were in great part collected by himself. They add considerably to the value of this excellent work.

D. G. BRINTON.
UNIVERSITY OF PENNSYLVANIA.

Wild Neighbors. By ERNEST INGERSOLL. New York, The Macmillan Co. 8vo. Pp. xii+301. 29 illustrations. $1.50.

Mr. Ingersoll's 'Wild Neighbors' are some of our native mammals, the red and gray squirrels, panther, coyote, badger, porcupine, skunk, woodchuck, raccoon, and incidentally many others, with which the author endeavors to make us better acquainted through interesting accounts of their habits. The biography of each species contains some descriptive notes and extended life histories, covering general habits, distribution, economic importance, and comparison with other species. The skunks of the genus *Mephitis* are compared with the mink, the European polecat, the stinking badger of East India, the honey badgers of South Africa, and our more closely related genera, *Conepatus* and *Spilogale*. One chapter is devoted to 'the service of tails, their use and importance to various creatures,' and is extended to include birds, reptiles, insects and crustaceans, as well as mammals. One is given to animal training and animal intelligence and deals mainly with domesticated species and those of the menagerie, discussing their capacity for learning.

The work brings together many interesting facts from the lives of our best known mammals in a popular style, with technicalities carefully omitted. To those who have had little to do with mammals or mammal literature it will prove new and interesting, a great part being taken by direct or indirect quotation from the works of Audubon and Bachman, Kennicott, Lord, Goode, Thoreau, Burroughs, Coues, Allen, Roosevelt, Merriam, Hornaday, Bicknell and many other well known authors. Unfortunately, however, less reliable sources have been drawn upon also and many misleading statements are made. The reader is told that the Eastern chipmunk (*Tamias striatus*) is now conceded to be the only species ranging between the Atlantic and

Pacific coasts, while in reality some 22 species and 12 subspecies are now recognized in the United States. The nuthatches are erroneously classed with the woodpecker as birds that use their tails for support in climbing over the trunks and branches of trees. Young opossums are said to go about clinging to their mothers' tails soon after they are born.

The book contains much that is good in its way; but unless the reader exercises more knowledge of mammals than the author seems to possess, he will be unable to decide what should be accepted as reliable and what rejected as unreliable. To the student of mammals if offers nothing in the way of new and original matter. The nomenclature is out of date, a large proportion of the generic and specific names differing from those in present use.

The author has experienced the usual difficulty in obtaining illustrations of mammals. The few that appear to be new are evidently taken from badly mounted specimens and are wretchedly drawn. The reproductions from previous works are not the best that might have been selected, and in most cases the reader is left to guess where he has seen them before.

VERNON BAILEY.

SOCIETIES AND ACADEMIES.

BOSTON SOCIETY OF NATURAL HISTORY.

A GENERAL meeting was held November 17th, seventy-one persons present. Dr. B. L. Robinson spoke of the flora of some of the islands of the Pacific, noting the various classifications of islands proposed and mentioning examples of the different classes. Insular floras show a paucity of species compared with genera; Leguminosæ are rare on oceanic islands. Dr. Robinson sketched the history of botanical exploration of the Galápagos and prefaced the result of his work upon the collections of Dr. Baur with an account of the classic studies of Hooker and Andersson. The flora of the upper, moister portions of the Galápagos is closely related to floras of Central America, Mexico and the West Indies, while in the lower, or desert portions, the flora has been derived from Peru and Chili. Dr. Robinson also gave a brief account of the flora of some of the Californian islands, and mentioned their resemblance to the flora of the Galápagos in the number of endemic types. The study of the flora of the Californian islands confirms Le Conte's theory that they were united with the main land up to Quaternary times.

Professor A. E. Verrill discussed the causes that determine the flora and fauna of the smaller islands off the New England coast, referring particularly to the Thimbles and other islands in Long Island Sound. The islands north of Cape Cod differ from those south of the Cape, though both are governed by the same principles; compared with the mainland the animals are few in number. The meadow mouse, *Arvicola sp.*, is the most important factor in regard to the flora, though the introduction of sheep and goats does much to change the vegetation. Many birds found on the Thimbles do not breed upon them. Reptiles are entirely wanting, and when introduced do not survive. With the exception of the red-backed Salamander, *Plethodon*, there are no Amphibians; the *Plethodon* is abundant and is frequently found associated with marine Crustaceans. The surface soil, though rich and black, did not originally contain earthworms; introduced later, they are now abundant. The larvæ of Scarabæidæ and Myriopods belonging to *Spirobolus* and *Polydesmus* were exceedingly abundant and replaced the earthworm. The *Polydesmus*, owing to the lack of fresh water and to the effect of salt water, is now extinct on the Thimbles. With insects the number of species is small; they swarm more rapidly and are more injurious than on the mainland. Of the Mollusca, two *Helices* and a *Succinea* abound; slugs are wanting. The plants are the same as those of the mainland, but only a limited number can withstand the adverse conditions caused by the salt spray, ravages of mice, drought, action of storms, etc. Certain plants are more hardy, grow more rapidly and flower more abundantly than the same species on the mainland.

Professor Verrill showed a number of drawings of marine invertebrates; painted in oil directly upon tiles and ground-glass tablets, they are helpful for purposes of museum illustration.

SAMUEL HENSHAW,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

AT the 68th meeting held in Washington, D. C., November 24, 1897, Mr. M. R. Campbell made a brief informal communication on the Laminated Clays of Teay Valley, W. Va., and their origin and significance. The problem is but part of the broader problem of the physiography of that portion of West Virginia, which it is proposed by Mr. Campbell to consider on a future occasion.

Mr. J. S. Diller followed with a communication on 'The Origin of Camas Swale.' One of the principal tributaries of the Umpqua River in southwestern Oregon is the Calapooya. It rises upon the western slope of the Cascade Range, and near the eastern escarpment of the Coast Range enters the Umpqua River, which, in a remarkably meandering canyon, passes through the mountains to the Pacific. The general direction of the Calapooya is southwestward, parallel to the strike of the rocks, but nearly midway in its course it turns sharply to the northwest, and for four miles cuts directly across the general trend of the ridges and valleys. At this sharp turn heads a broad, shallow valley, known as Camas Swale. Its bottom is a plain stretching to the southwestward for about seven miles, with a width of from one to two miles. The swale is drained by Wilbur Creek, a small stream which enters the north fork of the Umpqua and for the greater part of its course is dry in summer. Camas Swale and much of the valley of Wilbur Creek, is larger than one would expect as the work of so small a stream, when compared with that accomplished by other streams of equal size in the same region.

The relation of Casmas Swale to the Calapooya suggests that it may once have been the bed of that stream. The principal flood-plain of the Calapooya is continuous with that extending through Camas Swale, and the pebbles of the bed of Wilbur Creek in the swale are largely volcanic rocks, such as could have been brought from the Cascade Range only by the Calapooya River. The size of the swale, too, bespeaks the action of a stream like the Calapooya, so that the evidence is quite clear that the Calapooya once flowed through Camas Swale, and by way of Wilbur Creek entered the north fork of the Umpqua.

Why did it change its course? The reason is to be found in the relation of Oldham Creek to the original course of the Calapooya. Along Camas Swale the two were originally parallel for a number of miles and separated by only a narrow ridge of sandstone. Oldham Creek reached the Umpqua by a direct course in six miles, while the water of the Calapooya, to reach the same point, had to travel twenty miles. Consequently, Oldham Creek, having the greater declivity, cut down its bed more rapidly than the Calapooya and enabled one of its side streams to cut through the dividing ridge and tap the Calapooya at the head of Camas Swale, thus diverting the waters of the Calapooya to their shorter course and leaving Camas Swale to be drained by Wilbur Creek, the beheaded portion of the ancient Calapooya.

W. F. MORSELL.

U. S. GEOLOGICAL SURVEY.

ENTOMOLOGICAL SOCIETY OF WASHINGTON, DECEMBER 2, 1897.

DR. F. C. KENYON, Washington, D. C.; Mrs. Annie Trumbull Slosson, New York city; Mr. R. J. Weith, Elkhart, Ind., were elected members. Officers for 1898 were elected as follows: President, Mr. H. G. Hubbard; Vice-Presidents, Dr. T. N. Gill and Dr. H. G. Dyar; Corresponding Secretary, Mr. Frank Benton; Recording Secretary, Dr. L. O. Howard; Treasurer, Mr. E. A. Schwarz.

Mr. Hubbard exhibited specimens in all stages of *Dinapate wrightii*, a very large and very rare Bostrichid beetle, the habits of which were not previously known, and which, in fact, was described from a fragmentary specimen only. Mr. Hubbard finds that this insect breeds in the trunks of *Washingtonia filifera* in southern California. He considers that the species is rapidly approaching extinction and calls it the Dodo of beetles.

Mr. Cook exhibited a new genus of Schizonotidæ, a family related to the whip-scorpions and at present containing two genera—*Schizonotus* and *Tripeltis*. The new form was discovered by Mr. Hubbard in Arizona and is distinct from others in containing two small

wedge-shaped sclerites in the transverse fissure of the cephalothorax. Mr. Cook dedicates the genus to Mr. Hubbard and the species may be called *Hubbardia pentapeltis*.

Mr. W. G. Johnson read a paper on Isaac P. P. Trimble, economic entomologist, giving an account of Mr. Trimble's life and exhibiting photographs taken at different ages and a large series of unpublished plates prepared under Mr. Trimble's direction for a second volume of his work on fruit insects. The plates excited considerable interest from their excellence.

Dr. Dyar presented a note on an external feeding hymenopterus parasite. This is a new species of the Ichneumonid genus *Pammicra*, which lays its eggs on a Nematine saw-fly larva, feeding upon black oak on Long Island. The parasite paralyzes the larva with its sting, lays two eggs upon its dorsum, and the parasitic larvæ feed externally, remaining in the larval condition five days.

Mr. Ashmead read portions of a systematic paper on the genera of the Eucharidæ and presented a new classification of the old family Chalcididæ, which he will make a super-family, Chalcidoidea, containing fourteen families.

L. O. HOWARD,
Recording Secretary.

TORREY BOTANICAL CLUB, OCTOBER 12, 1897.

No regular program had been prepared for this meeting, but notes detailing some results of summer's work were presented by Drs. Rusby and Underwood, Mr. Van Brunt, Mrs. E. G. Britton, Judge Brown, Mr. Eugene Smith, Mr. M. A. Howe and Miss Ingersoll.

Dr. H. H. Rusby spoke of his work at the Kew Herbarium in identifying some 2,000 plants of two Bolivian collections. As an indication of how the Columbia University has grown in the last few years, he noted that in working up a similar collection four years ago he was able to determine but 5 or 6 % by comparison with the plants in this herbarium, while of the present collection nearly 50 % were identified by this means. He added that the herbarium at Kew is also growing rapidly, and in four years has added to its collections nearly half as many specimens as are in the Columbia Herbarium. Dr. Underwood remarked that the Kew Herbarium is superior to the Paris Herbarium even in the plants of the French provinces. Of these, many are represented at Kew and not at all at Paris.

Mr. Cornelius Van Brunt spoke of his journey to the Selkirk and Rocky Mountains of British America, making many photographs of new or interesting plants.

President Brown described a precipice in the Shawangunk with an altitude of 2,200 feet, bearing pine trees on its summit only six inches high but with perfectly developed cones. Throughout the region *Arenaria Groenlandica* was abundant in bloom from June to September, most copiously in July. He remarked upon the abundance and profuse bloom of *Gentiana quinquefolia*, *Kalmia latifolia*, *Rhododendron maximum*, *Ilex montana* and the *Rhodora*.

EDWARD S. BURGESS,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis on the 6th of December, 1897, fifty persons present, Mr. Julius Hurter exhibited specimens of a considerable number of reptiles and batrachians, mostly of Southern origin, which had been collected by him during the past season, and were additions to the known fauna of Missouri. Among the more interesting additions were the cotton-mouth moccasin, the banded water snake, Holbrook's water snake, the little brown snake, the Louisiana mud turtle, the chestnut-backed salamander (first detected west of the Mississippi River by Mr. Colton Russell), and the marbled salamander.

Mr. H. von Schrenk exhibited a series of specimens and drawings illustrating some of the injuries inflicted on the trees of St. Louis by the tornado of May, 1896, showing not only the formation of double twig elongation and growth rings, but the exfoliation of the bark and the consequent drying-out of fifty per cent. or more of the wood through the trunk and branches in several species.

One new member was elected, and one person was proposed for active membership.

WILLIAM TRELEASE,
Recording Secretary.

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; C. E. BESSEY, N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; C. S. MINOT, Embryology, Histology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, DECEMBER 24, 1897.

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MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison-on-Hudson, N Y.

THE FOUNDERS OF GEOLOGY.

THE geologists of America in April of the present year welcomed to this country Sir Archibald Geikie, the distinguished Director-General of the Geological Survey of Great Britain and Ireland, on the occasion of his coming to give the opening course of lectures upon the George Huntington Williams memorial foundation at the Johns Hopkins University. The many representative men from all portions of America who went to Baltimore to listen to him shows the high position of authority which he holds in geological science and the desire which was universally felt to do honor to the man. Those who met him and listened to his carefully prepared words gained an inspiration which will be long felt in geology on this side of the Atlantic.

The lectures, which have been recently printed, appear in an attractive form from the Macmillan press.* In the introduction to the *first* lecture of the course the author states that the searcher after truth is liable to lose sight of the paths already trodden, and that it is, therefore, "eminently useful now and then to pause in the race, and to look backward over the ground that has been traversed, to mark the errors as well as the successes of the journey, to note the hindrances and the helps which we and our

* *The Founders of Geology*, by Sir Archibald Geikie, X. 297 pp. 1897. Macmillan & Co., London. The Macmillan Company, New York.

predecessors have encountered, and to realize what have been the influences that have more especially tended to retard or quicken the progress of research." For that purpose the epoch which extends from the middle of the last century to the earlier decades of this is especially selected as the period when the real foundations of geology were laid, although it is freely recognized that many honored names in the domain of the science antedated this time.

After referring to the curious coincidence of the appearance of the writings of the two last and most eminent of the cosmogonists, Leibnitz and Buffon, in the same year during the middle of the last century, the author proceeds in most interesting manner to describe the life and work of the hitherto little recognized Guettard (1715–1786), who, by his brilliant researches in many lines, may be truly called one of the founders of modern geology. To Guettard we owe the first practical attempt to construct geological maps by depicting the superficial distribution of mineral substances. It is doubtful, however, if he had very definite ideas regarding the sequence of formations or of geological structure. His map of western Europe, so far as it relates to the areas of his own observations in France, coincides in a broad way with the modern conception of the distribution of the stratigraphical series, although often erroneously grouping younger with older deposits in his 'bands.' Guettard's contributions in the field of paleontology are also of much significance. He recognized the importance of fossils in geological research, and published many large and elaborate memoirs in which numerous forms are figured and described. He was the first to recognize *trilobites*. The excellence of his descriptions and drawings entitle him to rank according to the author as 'the first great leader of the paleontological school of France.' His memoir 'On the Accidents that have befallen Fossil Shells compared with those which are found to happen to Shells now living in the Sea,' which appeared in 1765, is regarded as unquestionably one of the most illustrious in the literature of geology, as it introduces a natural explanation for the phenomena of organic remains entombed in the rocks.

To the field of physiographic geology his memoir 'On the Degradation of Mountains effected in Our Time by Heavy Rains, Rivers and the Sea' contributed much and must be regarded as one of the classics of that department of the science. No one had elaborated the subject so fully as he at that period.

The recognition by Guettard of the volcanic origin of the mountains of the Auvergne affords one of the most interesting chapters in the whole book. It is one of the curious facts connected with his remarkable career that these views "practically started the Vulcanist camp, and his promulgated tenets regarding basalt became the watchword of the Neptunists." It seems that he was "an indefatigable and accurate observer who, gifted with a keen eye, well-trained powers of observation, and much originality of mind, opened up new paths in a number of fields which have since been fruitfully cultivated, but who rigidly abstained from theory or speculation."

In the *second* lecture the author discusses the rise of volcanic geology as shown by the work of Desmarest, and also the beginning of geological travel by Pallas and de Saussure. To Desmarest (1725–1815), a public official and astute scientific observer, we owe a further elucidation of the geology of the classic volcanic district of the Auvergne, which had been the scene of so much of Guettard's labors. Although Guettard had observed the general volcanic character of the district, it was Desmarest who, in great detail, traced out the disposition of these various rocks and others, unrecog-

nized by his predecessors, and who endeavored to establish a system of succession among them. This led him to a study of the denudation which the several lava streams had suffered, and thus to the most comprehensive statement of the effects of erosive action based upon concrete examples which had up to that time appeared. One of the most important conclusions of Desmarest's investigations in the Auvergne was the recognition that basalt was of eruptive origin, although he found few supporters for his views and did not enter later into the prolonged discussion which arose upon the subject. His map of the Auvergne elaborated in great detail, although unpublished at the time of his death, may still be regarded as his greatest contribution to geology, and was certainly far in advance of any other attempt at the cartographic representation of geological phenomena of its day.

Desmarest also contributed four massive volumes upon Géographie Physique in the famous Encyclopédie Méthodique, and had not completed the last at the time of his death in his ninetieth year. Cuvier, in his biographical sketch of him, says: "The Academy of Sciences saw in him, as it were, the monument of a bygone age, one of those old philosophers, now too few, who, occupied only with science, did not waste themselves in the ambitions of the world, nor in rambling through too wide a range of study, men more envied than imitated."

A factor which added much to the advance in scientific thought of last century was the rise of the spirit of scientific travel. To Pallas (1741–1811), who spent six years, from 1768 on, at the head of a scientific expedition commissioned by Empress Catherine II., we owe much important geological information regarding a portion of the world then but little known. His study of the Ural chain led to his attempt to classify the rocks of mountain areas, the chief value of his observations lying "in his clear recognition of a geological sequence in passing from the center to the outside of a mountain chain. He saw that the oldest portions were to be found along the axis of the chain, and the youngest on the lower ground on either side." One of the geological questions which especially occupied his attention was the occurrence of the remains of the fossil elephant, rhinoceros and buffalo throughout the whole vast basin of Siberia, between the Ural and Altai mountains.

Few men have better claim to be regarded among the founders of geology than de Saussure (1740–1799), who was the first to arouse the modern spirit of mountaineering, and whose indefatigable travels throughout the high Alps contributed so largely to the stock of ascertained fact which was so useful as a basis for theoretical speculation. To de Saussure we owe the first use of the terms geology and geologist, while his experiments upon the fusion of rocks, although only negative results were obtained, are especially interesting, as they mark the earliest beginnings of experimental geology.

The *third* lecture deals with the history of the doctrine of geological succession, and the influence of Wernerianism upon the geological thought of the day. Lehmann, Fuchsel and Werner more than any others during the latter half of the last century advanced the ideas of geological succession. Lehmann (died 1767) published, in 1756, the first treatise in which a definite attempt is made at a chronological classification of the rocks of the earth's crust. He recognized, from a study of the rocks of the Harz and Erzgebirge, three major orders which became the Primitive, Secondary and Alluvial divisions of the proposed classification. His profiles of the succession of strata showed, according to the author, 'a remarkable grasp of some of the essential features of tectonic geology.' Contemporary

with Lehmann was Fuchsel (1722–1773), who in 1762 published one of the most remarkable works, with map and sections, which had 'up to that time been devoted to the description of the actual structure and history of the earth.' 'He recognized as clearly as Lehmann, and with more accuracy of detail, the sequence of stratified rocks,' and considered that 'the changes which the earth had undergone were of no abnormal kind.' In divining with singular sagacity 'that a continuous series of strata of the same composition constitutes a formation, or the record of a certain epoch in the history of the globe,' he anticipated, according to the author, 'a doctrine which afterward took a prominent place in the system of Werner.'

The most notable figure in the mineralogical and geological arena during the last quarter of the last century and the early years of this was Werner (1749–1817), who, chiefly by the vast influence of 'his personal gifts and character,' wielded an overmastering power upon the geological opinions of the time. Appointed professor at twenty-five in the Mining Academy of Freiberg, he gradually, by the brilliancy of his teaching, drew about him an enthusiastic body of pupils from all portions of the civilized world, and raised the local mining school into the position of a great university. "No teacher of geological science," says Geikie, "either before or since has approached Werner in the extent of his personal influence or in the breadth of his contemporary fame." His most distinguishing quality, he states further, was 'his overmastering sense of orderliness and method,' which made his contributions to the then half chaotic science of mineralogy of vast significance, although he wholly ignored crystalline form in his classification. In the study of the earth, for which he and his adherents used the term geognosy, he endeavored to apply the same precision, and laid down doctrines which he dogmatically applied, although there was generally no basis for them in observed fact. He adopted the idea that "the whole globe had once been surrounded with an ocean of water, at least as deep as the mountains are high, and he believed that from this ocean there were deposited by chemical precipitation the solid rocks which now form most of the dry land." His order of sequence, taken to a considerable extent from Lehmann and Fuchsel, was developed into a system of his own. He believed basalt and other eruptive rocks to be of aqueous origin, and all volcanic activity modern phenomena, produced by vast repositories of inflammable matter.

The greatest service which Werner rendered to the cause of geological science, according to the author, was the enthusiasm he inspired in so many capable men. Among the most distinguished of Werner's pupils were d'Aubuisson (1769–1819) and von Buch (1774–1853), who, although loyal to their master, gradually became convinced of the fallacy of many of his views, and finally practically abandoned them altogether. Curiously, they were led to these conclusions largely from a study of the district of the Auvergne, where in previous years Guettard and Desmarest had done such valuable work for the cause of geological science. Von Buch especially became one of the most prominent figures in European geology. He traveled widely, and the result of his investigations greatly enriched geological literature. In 1824 he brought out a geological map of Germany in forty-two sheets, while his contributions to the science covered nearly every branch of geological research.

The *fourth* lecture is devoted to the consideration of a very different school of geology than that described in the previous chapter. It had for a time far fewer supporters than the Neptunist System of

Werner, although in the end largely supplanting the latter. This opposing school had as its chief representative the Scotch scientist Hutton (1726–1797), who, although never wielding the personal influence of Werner, slowly developed, by actual observation, a system of geological thought that forms the basis of much of modern geology. Hutton himself published but little regarding his ideas. His chief work, entitled 'Theory of the Earth, with Proofs and Illustrations,' appeared in 1795; but Playfair (1748–1819), his friend, has given us, in his 'Illustrations of the Huttonian Theory of the Earth,' an admirable exposition of his views. Hutton, unlike Werner, had 'no preconceived theory about the origin of rocks,' but considered that 'the past theory of our globe must be explained by what can be seen to be happening now.' He observed that the greater part of the land consists 'of compacted sediment which had been worn away from some pre-existing continent, and had been spread out in strata over the bed of the sea,' and that the strata had often become 'inclined, sometimes placed on end or even stupendously contorted and ruptured.' Recognizing as of fundamental importance the internal high temperature of the globe, of which volcanoes are one of the proofs, he distinguished three types of eruptive rock—whinstone, porphyry and granite—which he considered had been intruded from below among the rocks with which they are now found associated. Hutton, to be sure, drew no distinction between mineral veins and dykes, referring them all to intrusive origin and even regarded the flint concretions of the Chalk to be of similar origin.

We find also in the Huttonian theory practically 'the whole of the modern doctrine of earth sculpture,' while there is also 'the germ of the Lyellian theory of metamorphism.' Even the modern conception of glacial action is foreshadowed in the recognition of the potency of glaciers in the transport of detritus. Hutton 'rigorously guarded himself against the admission of any principle which could not be founded on observation,' and never permitted himself to make any assumptions. It is said of him that 'he was a man absorbed in the investigation of nature to whom personal renown was a matter of utter indifference.'

Among Hutton's friends was Hall (1761–1830), to whom we owe 'the establishment of experimental research as a branch of geological investigation.' His experiments upon the fusion of rocks, in which he showed the effects of the rate of cooling upon texture, are of much interest in the history of volcanic geology. Other experiments upon the effect of pressure in modifying the influence of heat, and his machine for contorting layers of clay, are hardly less significant.

For a time the Huttonian views in Scotland received a setback by the appointment of Jameson (1774–1854), a pupil of Werner, to the professorship of geology at Edinburgh, but upon the death of the great master, in 1817, his views, already opposed openly even by some of his pupils, rapidly declined in favor, and the old controversy between the Neptunist and Vulcanist gradually disappeared.

The *fifth* lecture is devoted to a consideration of the rise of stratigraphical geology, as shown by the work of Giraud-Soulavie, Cuvier, Brongniart and D'Omalius d'Halloy in France, and Michell and William Smith in England. To Giraud-Soulavie (1752–1813) 'the merit must be assigned,' according to the author, 'of having planted the first seeds from which the magnificent growth of stratigraphical geology in France has sprung.' In a series of volumes upon the natural history of southern France, of which the first two appeared in 1780, he described the calcareous mountains of the Vivarais

and divided the limestones into five epochs or ages, the strata in each of which are marked by a distinct assemblage of fossil shells. He thought, however, "that the most ancient deposits had been accumulated at the highest levels, when the sea covered the whole region, and that, as the waters sank, successively younger formations were laid down at lower and lower levels," and "he felt confident that if the facts observed by him in the Vivarais were confirmed in other regions a historical chronology of fossil and living organisms would be established on a basis of incontestable truth."

Cuvier (1769–1832) and Brongniart (1770–1847) together studied in much detail the Tertiary formations of the Paris basin. They demonstrated in this area 'the use of fossils for the determination of geological chronology and they paved the way for the enormous advances which have since been made in that department of our science.' They brought forward clearly the evidence for 'a definite succession among the strata and the distinction of the organic remains contained in them.' Cuvier had already shown that the fossil elephant found near Paris belonged to a different species from either of the living forms, and by further research reconstructed the skeletons of other types, which enabled him to announce 'the important conclusion that the globe was once peopled by invertebrate animals which, in the course of the revolutions of its surface, have entirely disappeared.' The work of Cuvier and Brongniart upon the Tertiary formations has been but little altered, although greatly elaborated. The broad outlines sketched by them remain as true now as they were when first traced by them early in the century.

D'Omalius d'Halloy extended the work of his predecessors among the Tertiary formations, but, what is of more interest, 'recognized the leading subdivisions of the Cretaceous series and actually showed the extent of the system upon a map. This map is regarded as the first attempt to construct a true geological map of a large tract of France,' which was something more than 'a mere chart of the surface rocks.' It was provided with a horizontal section showing the structural relations of the formations.

In England, Michell is regarded as the first to present anything like a clear idea of stratigraphical sequence, a table giving the broad features of the succession of strata from the Coal Measures of Yorkshire up to the Chalk, having been drawn up by him about 1788 or 1789. Geikie very clearly points out, however, that "the establishment of stratigraphy in England, and of the stratigraphical sequence of the Secondary, or at least of the Jurassic, rocks for all the rest of Europe, was the work of William Smith," a land surveyor, usually known as the 'Father of English Geology.' "No more interesting chapter in scientific annals can be found," according to the author, "than that which traces the progress of this remarkable man, who, amidst endless obstacles and hindrances, clung to the idea which had early taken shape in his mind, and who lived to see that idea universally accepted as the guiding principle in the investigation of the geological structure, not of England only, but of Europe and of the globe." Smith made no attempt to publish his results, although he accumulated a vast store of notes upon his observations during his journeys in the pursuit of his profession. His ideas gradually became widely known, and a card of English strata from the Coal to the Chalk, drawn up in 1799, though not actually published, obtained wide publicity. His geological map of England and Wales with part of Scotland, in fifteen sheets, regarded as one of the great classics of geological cartography, and upon which he had been at work for many years, was not

published until 1815. The appearance of this map marked 'a distinct epoch in stratigraphical geology, for from that time some of what are now the most familiar terms in geological nomenclature passed into common use.' Smith also published geological maps, on a larger scale, of the English counties and a series of horizontal sections across different parts of England.

The *sixth* and last lecture deals with the further development of stratigraphical geology along lines laid down by Smith and his distinguished contemporaries, who had applied the criteria derived from fossils with such success. Smith's researches, as we have seen, did not include rocks older than the Coal Measures. The great mass of earlier strata known in the old classification as Greywacke, or Transition, rocks were regarded in their generally disturbed and poorly fossiliferous condition to be beyond interpretation by the principles of Cuvier, Brongniart and Smith, until Murchison and Sedgwick, for the most part, 'working independently of each other in Wales and in the border counties of England,' succeeded in establishing a definite order among the oldest fossiliferous formations, thus adding the Devonian, Silurian and Cambrian chapters to the geological record.

Murchison (1792–1871), after several years of investigation of the Secondary rocks of England and the Continent, and some preliminary work with Sedgwick upon the old rocks of the northern counties of England, began in 1831 in Wales and the adjoining counties of England his epoch-making study of the strata below the Old Red Sandstone. Starting with that already known and easily recognizable horizon he established a series of underlying divisions which he found to be characterized by peculiar fossils. To this assemblage of formations, which he divided into an Upper and a Lower series, he gave the name of Silurian System. He recognized its conformity to the Old Red Sandstone, but wrongly thought it to rest unconformably upon the older series of greywacke. Murchison also worked out the lithological character of these old rocks, observing eruptive materials among them, some of which he clearly saw were intrusives, while others he recognized to be lavas and ashes. His first communication upon this subject was made to the Geological Society of London in 1831, his great book, 'The Silurian System,' appearing in 1838. The author tells us that even before the advent of this volume his remarkable results had become widely known and 'within a few years the Silurian System was found to be developed in all parts of the world,' Murchison's work furnishing the key to its interpretation.

Sedgwick (1785–1873), almost from the very beginning of his career, devoted his energies to the ancient rocks, his earlier publications, however, showing strong leanings to the Wernerian school. He soon parted with these views and early came to a true perception of geological principles which he applied in a study of the older formations of northern England. The author tells us that though fossils had been found in the rocks Sedgwick did not at first make use of them for purposes of stratigraphical classification, but ascertained the succession of the great groups of strata upon lithological grounds alone. He, as well as Murchison, recognized volcanic rocks to form part of the greywacke rocks of North Wales and soon 'succeeded in disentangling their structure and ascertained the general sequence of their principal subdivisions.' At this period, however, his investigations were of far less significance in the field of general stratigraphy than Murchison's, since he had not determined the relation of his rocks to any well recognized horizon and had made no use of fossils for correlative purposes. Later investigations showed that the upper part of what Sedgwick termed the Cambrian system con-

tained the same organic remains as the Lower Silurian formations defined by Murchison, and thus arose a permanent misunderstanding between these two old friends and leaders in English geological thought.

While this dispute was in progress Barrande made his remarkable investigations in the Bohemian basin, where he not only recognized the equivalents of Murchison's Upper and Lower Silurian, but also found a still older group of strata containing forms similar to those occurring in Sedgwick's Cambrian system. To the latter fauna he gave the name of First or Primordial fauna. The consensus of geological opinion, on the grounds of priority, to-day regards as Lower Silurian the Upper Cambrian of Sedgwick. Sedgwick's classification, however, in these old and disturbed rocks has proved of vast importance in the elucidation of the ancient sediments, and the succession of strata observed by him has continued with hardly a modification to the present day.

A no less important work pursued by Sedgwick and Murchison together in the days before their estrangement was the determination of the Devonian. Its reference in the absence of stratigraphical data to a position between the Silurian and Cambrian was based mainly upon the paleontological work of Lonsdale, who pointed out that the fossils in its lower portions showed an affinity to the Silurian while those in its upper parts were closely allied to the Carboniferous faunas.

The pre-Cambrian rocks now remained to be studied and deciphered. The paleontological criteria were no longer available and many difficulties presented themselves. "The first memorable onward step," according to Geikie, "was taken in North America by Logan (1798–1875)." Some study had already been given to these old rocks, but Logan was the first to attempt to establish a chronological sequence among them. To him we owe the names Laurentian and Huronian, and although his results have been much modified by subsequent observers his work marks a distinct advance in this field of stratigraphical geology.

The first recognition of the wide significance of glaciers as geological factors of more than local importance must be accorded to Agassiz (1807–1873). He was the first to offer a satisfactory explanation for the so-called erratics, which were found distributed over the Swiss plain and the flanks of the Jura mountains. Contrary to the preconceived notions of the day, he held that the Alpine ice once extended over the area and that it was an explanation of a former period of extreme cold. His further researches in England, where he found similar phenomena, convinced him that the great extension of ice was connected with the last great geological change on the surface of the globe. These teachings of Agassiz, which to-day, in all their essential elements, have been generally accepted, place his name, according to the author, as that of 'the true founder of glacial geology.'

The attempts at geological classification upon lithological grounds, which had been pushed to such an extreme by Werner and his followers, greatly declined after the marvelous impetus which the study of organic remains brought to the science of geology. But the investigation of rocks in their mineralogical aspects was not to be permanently abandoned. The invention of the famous prisms of Iceland spar by Nicol and the cutting of thin sections introduced a new element into geological investigation, but it was not until Sorley extended this method by the more systematic examination of thin sections that microscopical petrography became recognized in the field of geological research. The publication, in 1858, of his memoir 'On the Microscopic Structure of Crystals' marks one of the most prominent epochs in modern geology. There was at first much opposition to this method

of investigation, but it soon had many devoted followers who have done much to advance the science, among the more important being Zirkel, Rosenbusch, Fouqué and Michel Levy.

There yet remain two illustrious names to be mentioned among the founders of geology. They are Charles Lyell and Charles Darwin. Lyell (1792–1875), who exercised a profound influence on the geology of his time, adopted the principles of Hutton, and with marvelous industry collected a vast store of facts in support of the doctrine that 'the present is the key to the past.' He pushed the Huttonian doctrine to its logical conclusion and became the great leader of uniformitarianism, a creed which, according to the author, 'grew to be almost universal in England during his life, but which never made much way in the rest of Europe.' Lyell's 'Principles of Geology' must certainly be regarded as one of the classics of our science. To Lyell, in conjunction with Deshayes, we owe the classification of the Tertiary into Eocene, Miocene and Pliocene, upon the basis of the proportion of living species of shells. Lyell was not so much an investigator as 'a critic and exponent of the researches of his contemporaries.' Ramsey said of him, "We collect the data, and Lyell teaches us to comprehend the meaning of them."

Darwin (1809–1882) did much, not only by his contributions to the literature of geology, but in the introduction of the doctrine with which his name is associated, to revolutionize the geological thought of his time. His demonstration of the imperfection of the geological record and the great antiquity of the earth's crust came, according to the author, 'as a kind of surprise and awakening.'

In concluding the lectures the author calls attention to three prominent facts: first, that but three of the men considered, Werner, Sedgwick and Logan, could be called professional geologists, the others being either men of leisure, as Hutton, Hall, de Saussure, von Buch, Lyell and Darwin, or professionally engaged in other pursuits, as was the case of the great majority; second, that geology affords 'some conspicuous example of the length of time that may elapse before a fecund idea comes to germinate and bear fruit,' as, for instance, the length of time taken for the true principles of stratigraphical geology to become recognized; and third, that 'one important lesson to be learnt from a review of the early history of geology is the absolute necessity of avoiding dogmatism' the examples of the Wernerian catastrophist and uniformitarian schools being cited.

In endeavoring to give a somewhat comprehensive review of this latest important work of Sir Archibald Geikie it has been impossible to bring out clearly the delightful biographical and personal touches which so charm the reader. In the summary of the work which I have given it has been my endeavor to use, so far as possible, the phrases and happy expressions with which the book so richly abounds. The volume is one of much significance to the student of geology, as it for the first time presents to English readers anything like a satisfactory statement of the development of geology. Many of the men to whom we owe so much regarding our modern views of the science, and whose work has been but little considered by recent writers, are brought before us in their true proportions. The book must take high rank among the many other masterpieces of the distinguished author.

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CHARACTERS, CONGENITAL AND ACQUIRED.

II.

ACQUIRED physical characters (properly so termed) may involve not only quantitative changes, which alone we have as yet considered, but qualitative changes also.

Here, again, a wide field for investigation presents itself. For example, in man exercise does not merely cause a muscle to increase in size; it occasions besides, as in athletes after training, an increase in efficiency (*i. e.*, in the power and duration of contraction), which is greatly out of proportion to the increase in size. Intermittent friction or heat or other irritant (*e. g.*, chemical) not merely causes the skin to thicken, as in corns and callosities; it renders it denser also. Again, stimulation (that is use) may result in change which is wholly qualitative. Thus eyes which, when unaccustomed to the task, are rendered sore by the continued scrutiny of small objects (*e. g.*, print, as in the case of an adult learner) may by practice be trained, without apparent physical change, to endure this proceeding without damage. Most of these qualitative changes are best studied in connection with mind, but there is one series, of vast importance to the higher animals, and especially to man, which is entirely physical, and to which I may, in conclusion of this part of my subject, draw attention. I allude to the power which Natural Selection has developed in high animals of acquiring capabilities of resisting various poisons, particularly those offensive and defensive poisons (toxins) which are secreted by various plants and animals. Thus men acquire greatly increased powers of 'tolerating' nicotine and opium, which are *toxins* secreted respectively by the tobacco and poppy plants to protect them from organisms to which they are liable to fall a prey. Thus also man may acquire the power of 'tolerating' the poisons of various species of parasitic micro-organisms which afflict him and the higher animals, and which are the cause of that great class of diseases known as zymotic. These toxins, also, are defensive products by means of which the pathogenic organisms ward off the attacks of the phagocytes in the blood of the host by which they are liable to be destroyed.* When the phagocytes, through experience of the toxin, acquire the power of tolerating it they destroy the microbes whereby *acquired immunity* is achieved, as in chicken-pox, measles, scarlatina, small-pox, typhoid, etc. Without this power of acquiring immunity (temporary or permanent) there could be no recovery from such a disease as measles, for instance; and therefore, since, unlike malaria, for instance, most of these diseases pass from one infected person to another, and are for that reason diseases of comparatively dense populations. Without this power of acquiring immunity no dense populations could exist. In other words, if this power of acquiring immunity had not been evolved in man, civilization would have been impossible.

I have said that the power of acquiring physical traits does not exist among low animals, or, if it exists, does so in proportion as they are lowly placed in the scale of life, to an extent very small as compared to its development among high animals. If I am right as to this, low animals (*e. g.*, invertebrates) should be incapable or little capable of acquiring immunity against zymotic disease. I am not aware, however, that any observations on the subject have been made.

I dare say that many who read the foregoing will be inclined to dispute the facts and inferences put forward, and to urge, for instance, that I have not established any proof, nor even brought forward convincing evidence, of the truth of my assertion that low animals are incapable, or less capable than high animals, of acquiring physical characters. There is, in truth, no literature to which I can appeal, for the question is

* Vide *The Present Evolution of Man*, pp. 199–32 (London, Chapman & Hall, 1896), and an 'Address on Acquired Immunity,' by the author, *Lancet;* September 11, 1897.

entirely new; and therefore, also, so far as I am aware, no experiments directly bearing on it have been made. Moreover, in the highest animals all acquired physical characters are merely extensions of previously existing inborn characters. Thus the limb of an infant, which is compounded, as we may suppose, almost entirely of that which is inborn, grows under the influence of exercise and use into an adult limb. There is a sharp dividing line, but we cannot perceive it; and, therefore, as regards the infant's limb, we cannot as yet say where the inborn ends and the acquired begins. But in mind, which we have next to consider, the case is often very different. There the inborn is often sharply marked off from the acquired, and we shall find it emphatically true that low animals are infinitely less capable of acquiring mental traits than high animals. Whence, reasoning by analogy, we may, with some confidence, assert that if, as regards mind, the statement is true, in the absence of evidence to the contrary, it is probably true also as regards the physical parts.

Mind, doubtless, owes its origin to movement—to the necessity for coördinated movement in the various parts of the complex cell-community which we call a multicellular animal. Neither mind nor nervous tissue, the organ of mind, exists in plants, among which there is little or no movement. So, also, low in the animal scale, as among sponges, in which cells are not coördinated to perform movements *en masse*, there is no mind nor any need for it. Higher in the scale, as among Cœlenterates, in which masses of the cells combine to perform macroscopic movements, we begin to find traces of nerve tissue, but as yet there is, so far as we are aware, no mind. All movement apparently is purely reflex. Yet higher in the scale, as among the Mollusca in which the increasing complexity of the environment necessitates increasingly complex coördinated movements of masses of the cell-community, the nervous mechanism by means of which this coördination is carried out becomes still more developed and complex, and mind apparently dawns. So far as we know, consciousness then first appears, and with consciousness the rudiments of instinct.

I have elsewhere defined instinct as "the faculty which is concerned in the conscious adaptation of means to ends by virtue of inborn inherited knowledge and ways of thinking and acting."* In other words, instinct depends wholly on congenital characters, and not in the least on those which are acquired. This definition of instinct is far different from those which have hitherto found acceptance, but I think on consideration it will be found that it more correctly describes what we commonly mean by the term than any other hitherto put forth. By instinctive action do we not mean action which is independent of all previous experience and therefore of acquirement? When an insect secures its proper food in the proper way, spins a cocoon, mates with an individual of the opposite sex, or lays its eggs, with fit provision for the future, in an appropriate place, does it not act solely by virtue of inborn inherited knowledge and ways of thinking and acting, and, since it is unguided by experience, not in the least by virtue of knowledge and ways of thinking and acting which are acquired? To the mind of every naturalist will at once occur innumerable instances of actions, some of them extremely complex and elaborate, performed by insects and other comparatively low animals, in which experience can play no part; in other words, which are wholly independent of acquired knowledge and ways of thinking and acting. By means of instincts animals are enabled to place themselves in harmony with an environment infinitely more complex than

* *The Present Evolution of Man*, p. 137.

that to which reflex action alone can adapt them. The element of consciousness and its outcome, choice, are introduced. The conscious animal, unlike the unconscious, is enabled to choose between two or more courses, to which two or more instincts impel him. Thus the male spider approaches the gigantic female, guided by both the mating and life-preserving instincts, and all the complications of his subsequent conduct are due to his power of choice between two or more courses.

Higher in the scale, concurrently with the evolution of the power of acquiring physical traits (properly so called), is evolved the power of acquiring mental traits. It increases in successively higher animals, and at length, in the highest animals, becomes of such importance that it overshadows and replaces instinct, which, since it no longer holds a commanding place as a factor in survival, undergoes great retrogression.* If I can make my readers grasp all that is implied in the above I think they will admit the vast importance I have claimed for my subject—an importance which is not only from the standpoint of the man of science, but from many other standpoints, such as those of the moralist, the sociologist, the statesman, the philanthropist, the physician and others as well.

Let us contrast two animals which, for convenience, we may regard as at opposite ends of the scale, the dragon-fly and man. Tennyson's beautiful lines occur to me. I quote from memory :

> To-day I saw the dragon-fly
> Come from the wells where he did lie.
> An inner impulse rent the veil
> Of his old husk. From head to tail
> Came out clear plates of sapphire mail.
> He dried his wings ; like gauze they grew.
> O'er crofts and pastures, wet with dew,
> A living flash of light he flew.

Physically, like other low animals, the dragon-fly does not develop in response to exercises and use, or, if he does, it is to a very small extent compared to higher animals. Natural selection has nicely coördinated his structures, but has not evolved in them (at least to an appreciable extent) the power of developing further and in the right direction during the changing stress of circumstances. For example, his principal organs of locomotion, his wings and the structures which subserve them, are certainly wholly inborn. Mentally, at the beginning of each stage of his existence he is able to coördinate his muscles perfectly, and thus at the beginning of each stage his locomotion is apparently as good as at the end. Both in the water and in the air he knows what food to seek, and what enemies to avoid, and how to do so. At the fit time, impelled by an inborn impulse, he leaves the water, and, having undergone his last metamorphosis, is able, at once, to adapt himself to life in an entirely new environment, where the medium in which he exists, his mode of locomotion, his prey and his enemies are different, and where his procreating instinct comes into activity. But experience teaches him little or nothing; he cannot acquire mental traits; in other words, *he has little or no memory.*

Far different is the case with man. We have seen how much he acquires physically, so that the adult differs from the infant mainly in traits which he acquires, not in those which are inborn. Mentally, his powers of acquirement are even more remarkable; and, therefore, even more as regards his mental characters than as regards his physical characters, the adult differs

*Just as physical characters (*e. g.*, limbs of serpent, lost digits of horse, eye of proteus) undergo retrogression through atavism, wherebymore and more remote ancestral conditions are reverted to till that remote ancestral character is reverted to, when the character did not exist. Vide *The Present Evolution of Man*, pp. 18–30.

from the infant in that which is acquired, not in that which is inborn. At birth the infant's mind is a blank; he can coördinate only a very few groups of muscles (*e. g.*, the breathing, sucking and defæcating groups), and in these the coördination is never very delicate and elaborate. He knows nothing of his environment; he cannot, as can the dragon-fly, instinctively adapt himself to it. But gradually as his body develops under the influence of use and exercise, his mind develops also under the influence of experience, and the blank left by the retrogression of instinct is filled and more than filled by acquired knowledge and ways of thinking and acting. Slowly and painfully the infant *learns* to coördinate his different groups of muscles till at length he can perform such complex acts as speaking, writing and walking in which the coördination is exceedingly delicate and elaborate.* Much, very much, besides the power of coördinating his muscles is acquired by man. For instance, all the vast contents of his memory and all that arises out of memory are, of course, acquired. Here, again, all that is inborn is *the power of acquiring the contents of the memory*. I have elsewhere defined reason as 'the faculty which is concerned in the conscious adaptation of means to ends by virtue of acquired non-inherited knowledge and ways of thinking and acting.'* Compare, for instance, the construction of a cocoon by a caterpillar, or the first web spinning of a spider, to the construction of a house or the weaving of a net by a man. In the absolute absence of experience the caterpillar and the spider plainly act by virtue of inborn knowledge and ways of thinking and acting, in other words, by instinct; the man, on the other hand, as plainly acts by virtue of acquired knowledge and ways of thinking and acting, in other words, by reason.† In fact, so vast a part does the

*It has been denied (*e. g.*, *Lancet*, May 1, 22 and 29, 1897) that speech and bipedal progression are acquired. The denial arises from that habit of thinking in abstract terms which is the bane of many writers. One cannot speak without words, and every word is acquired and, therefore, speech itself is acquired. For instance, no one is born with the knowledge of the word 'brick.' Again, this sound (brick), like all others in a language, is produced by a particular and very delicate and complex coördination of the speech muscles, different from what is required to reproduce any other sound. The child *learns* to make this coördination, just as in after life he may learn to make that coördination from which results a foreign word, or that coördination of a different set of muscles from which results a written word. Again, a child *learns* to walk in just as true a sense as afterwards he may learn to bicycle. Speech and bipedal progression are common to the whole human race, and, therefore, they are invariably regarded as inborn characters. Writing and bicycling are not common to the human race, and, therefore, they are regarded as acquired; but very plainly the former are as much acquired as the latter. What alone is inborn is the *power of acquiring* speech and bipedal progression and vastly more besides.

* *The Present Evolution of Man*, p. 138.

† The terms 'instinct' and 'reason' are used very loosely even by scientific writers, the meaning of the former often being too much extended, while that of the latter is too much restricted. Thus, it is said, that we instinctively like or dislike this or that object, *e. g.*, man, implying thereby that we do so in the absence of experience. But the new-born infant (unlike the new-hatched fish) has no such instinctive like or dislike; his subsequent likings or dislikings arise as a result of experience, whether such experience remains as a recognizable part of consciousness or not. Again, actions which depend on acquirement, but which have become automatic from frequent repetition, are often termed instinctive, owing to the instinct-like absence of mental effort with which they are ultimately performed (*e. g.*, bipedal progression; vide *Present Evolution of Man*, pp. 144–5). On the other hand, the term rational is often restricted to such actions as conspicuously result from a correct chain of inferences, or to such as are not performed under the influence of violent emotion. For example, when an angry man embarks on foolish litigation we term his action irrational, thus expressly excluding it from the category of rational actions. But his action is certainly not reflex, nor, as certainly, is it instinctive, and, therefore, if we group all actions under the headings of reflex, instinctive and rational this action can belong to the last group only.

acquired factor play in all that is mental in man, that I have been unable to discover any action in him which is purely instinctive. Purely reflex actions he has in plenty, as, for instance, the movements of the various hollow viscera; but of the few instincts which survive in him (*e. g.*, parental and sexual love) none apparently are gratified without the aid of rational action. Consider, for instance, how greatly the instinctive appreciation of female beauty is modified by the acquired factor; there are savage tribes who mutilate, to render beautiful as they think, the faces of their women to a frightful degree.* Consider, again, how much there is rational (*e. g.*, the coordination of her muscles) in the mother's care of her offspring.

As in the case of physical characters, no systematic attempt has been hitherto made to differentiate between the mentally acquired and the inborn. As a result, much confusion and inaccurate thinking is manifest in writings, scientific and otherwise. I propose to deal with these to some extent presently; but first it would be interesting to trace, in however slight a manner, the evolution of the power of acquiring mental traits in animals. But, even before doing this, one other digression I may permit myself, since it has an important bearing on much that follows. It has been maintained that acquired characters, mental and physical, are transmissible. I will not here pause to consider whether such characters as I have ventured to denominate 'enforced,' nor whether such characters as result from the complete or partial reproduction of lost parts, are transmissible. The battle has been fought in countless publications, and I do not know that I have now anything very new or original to add; but I should like to say a little concerning the alleged transmissibility of such characters as result from use or experience, for instance, the acquired enlargement of the blacksmith's muscle through use, or the mental change involved in the acquirement of a knowledge of mathematics through experience. Characters like these are held by a section of biologists to be transmissible, in part at least. But when a parent acquires such characters they reappear in the child only in response to stimulation similar to that which caused them to arise in the parent. For instance, without such stimulation the child gets neither the enlarged muscles nor the knowledge of mathematics; in fact, the child must in all cases, acquire such characters afresh; from which it is plain that that which is acquired by the parent does not become inborn in the child.

It may, however, be maintained by Neo-Lamarckians that stimulation causes not only the acquirement of a character, but increases also the power of acquiring it, and that it is this increase in the parent which is transmitted to the child, and which renders more easy the acquirement of the character by the latter. But there is no tittle of evidence showing that the stimulation which results in the acquirement of a character (mental or physical) causes also an increase in the power of acquiring it. The converse is in fact true; the infant's power of acquiring characters, mental and physical, is immense, and to it is mainly owing the development he undergoes in his passage from infancy to old age; but this power steadily declines in his long stimulated parts (mental and physical), till in the old man it is reduced to a minimum and tends to vanish. Clearly, then, as regards such characters as result from use and experience there can be no transmission to the child; therefore, as regards them, evolution must have proceeded

* Our women have worn crinolines and chignons and still wear earrings and corsets.

wholly on lines of Natural Selection. Moreover, instincts (and such physical characters as are analogous to instincts, *i. e.*, inborn physical parts) cannot have resulted from the transmitted effects of experience and use, since they do not increase under such stimulation. There is, for instance, no reason to suppose that any instinct is sharpened by use, or, in other words, by experience. In fact, it would be a contradiction in terms to suppose that it is, since, if my definitions are right, all that is acquired pertains to reason, not to instinct. Moreover, did instincts increase under stimulation and were this increase transmissible in however slight a degree, then instincts should be most developed in the highest animals and less in lower animals. The contrary, however, is the fact.*

All acquired mental characters depend, of course, in the last analysis, on memory; and, therefore, an animal which is incapable of acquiring mental characters, and which, therefore, depends wholly on instinct, can have no recollection of past events, nor, as a consequence, any ideas concerning the future; it must live entirely in the present. To this it may be objected, however, that various insects display an instinctive memory, and, for instance, return again and again with food to the nest where they have laid their eggs. If, however, my definitions are correct these returns are not due to memory, but to an impulse (similar to that which causes them in the absence of experience to know a fit spot wherein to lay their eggs), which causes them again and again to return to this particular place, quite independently of any recollection of having been there before.† It has even

* It follows, then, from the above, that, except as regards the effects of mutilations, which I do not here consider, evolution can have proceeded only on the lines of inborn variations.

† Compare the swiftly forgotten alarm of a house-fly with the more and more permanent fear of successively higher creatures.

been denied that animals so high in the scale as fish possess a memory (the power of acquiring mental characters).* The seat of the memory has been held to be the cortex of the brain, and fish alone of all vertebrata have no cortex.† I think, however, there can be no doubt that fish have some power of acquiring mental traits, since trout in a much-fished stream soon grow more wary. Indeed, memory may be detected in animals much lower than the fish. Even so low in the scale as the oyster is a rudimentary capacity for mental acquirement observable, for "even the headless oyster seems to profit from experience, for Dicquemase asserts that oysters taken from a depth never uncovered by the sea open their shells, lose the water within and perish; but oysters taken from the same place and depth, if kept in reservoirs, where they are occasionally left uncovered for a short time and are otherwise incommoded, learn to keep their shells shut, and then live for a much longer time when taken out of the water."‡

As I have already said, speaking in general terms, the higher placed an animal is in the scale of life the greater is its power of acquiring mental characters, as will be apparent presently and as might have been expected; but it is also true that the higher species of a lower class or order often exhibit greater capacities for acquirement than

* Vide *Lancet*, January 23, 1897.

† And, therefore, in choosing the dragon-fly as an animal conspicuously lacking in acquired mental traits to contrast with man, in whom they are conspicuously abundant, I have not intended to imply that the former is quite incapable of acquiring mental characters, only that it is so little capable of acquiring them that it forms an admirable foil to man, the animal above all the most capable of such acquirement. I do not *know* that the dragon-fly is quite lacking in this quality, but only that it is so little developed in him that I personally, with my imperfect knowledge, have not been able to detect any traces of it.

‡ 'Animal Intelligence,' by Romanes, pp. 24, 25.

the lower species of a higher class or order. It is even true that some invertebrates exhibit far greater mental receptivity than many vertebrates. Speaking again in general terms, the power of acquiring mental characters is only developed to a considerable extent in such animals as tend their young, and in them it is developed in proportion to the length of time parental care is continued. Furthermore, it is developed to a very great extent only among such animals as not only tend their young for prolonged periods, but also lead gregarious lives. When animals, after laying their eggs, abandon them to chance it is clear in cases where mind (*i. e.*, consciousness and all that results from consciousness) plays a part in securing survival that such mind must be considerably developed from the moment of hatching. Hence it is that in such animals instinct greatly predominates. Moreover, they cannot acquire traits by imitation from their parents, and, therefore, whatever is acquired by the one generation is completely lost to the next; in other words, they have no traditional knowledge, and all that is mental in the individual is either inborn or has been discovered by himself. But when the animal, after birth, is protected for a prolonged period by its parent it is clear that instinct (inborn knowledge and ways of thinking and acting) becomes less necessary for survival, since an opportunity is afforded for acquiring fit knowledge and ways of thinking and acting from the environment, particularly from the parent. It is then possible for knowledge to become traditional, and to be handed down from parent to offspring. When, in addition, such animals lead gregarious existences the individual has the opportunity of acquiring mental characters, not only from the parent, but from other members of the community as well, and then complex mental acquirements have the best chance of being transmitted, instead of being lost. Under such circumstances the power of acquiring useful mental characters becomes a main factor in the struggle for existence, and those individuals that most possess it survive in the greatest numbers; and therefore, concurrently with the growth of knowledge, occurs an evolution of the power of acquiring knowledge and a corresponding retrogression of instinct, which, in the ancestry, was a main factor of survival, but is now no longer so.

I have given the dragon-fly as an example of an active animal which does not tend its young, and in which, therefore, instinct is developed to a high degree. The ant, on the other hand, is an animal which not only tends its young, but also lives in great communities; and we have striking evidence that some species of ants, at least, and probably all of them, are actuated largely by knowledge and motives which are acquired, *i. e.*, by reason, and not by inborn mental characters, *i. e.*, by instinct. Thus enslaved ants, captured as pupæ and educated wholly by their captors, differ markedly from the free members of the species; they have other knowledge and ways of thinking and acting; and the fact that the slaves, in their new homes, so readily adapt themselves to the changed environment, so readily exhibit knowledge and ways of thinking and acting which must be acquired and cannot possibly be instinctive, for the reason that their ancestry can never have been subjected to the influence of a like environment, proves how great a share reason has in all that is mental in them. And since the slaves clearly acquire mental traits which fit them for their duties as servants, it is not unreasonable to suppose that the slave-holders, in like manner, individually acquire the mental traits which fit them for functions as masters, *i. e.* that in them the slave-holding habit is not instinctive, but rational.

The lower vertebrata do not tend their young, which, therefore, are hatched highly endowed with instinct, but with little power of acquiring mental characters. Reptiles, having better developed brains, have greater capacities for acquirement than fish; they can be trained to a much great extent, can learn much more, and have been known to manifest affection for their masters, in which cases the acquired affection has been so strong as to overcome the instinctive dislike. Birds and mammals, like ants, tend their young, which, in proportion to the amount of protection accorded, are born helpless and devoid of instinct, but capable of mental acquirement. Ever, as we rise upwards in the scale, do we find this increasing protection associated with a growing helplessness at birth, and a steadily enlarging capacity for acquirement which finds physical expression in a more and more developed brain, especially of the cerebral portion of it. A partridge at hatching and a fawn at birth are able to coördinate their muscles to a considerable extent, and have many other instincts. The parrot and the pup are very much more helpless, but their capacity for acquirement is greater in proportion. Highest of all, the human infant is born absolutely helpless; it is unable to coördinate all but a very few groups of muscles; its instincts are reduced to a minimum; it cannot even seek the breast; but it is protected with prolonged and tender care, under which its vast powers of acquirement come into play.

Instincts, therefore, have undergone great retrogression in the higher types, but amid this general retrogression three instincts at least have undergone evolution: (1) the parental instinct to protect the offspring; (2) the parental instinct to impart to the offspring the acquired knowledge which subserved the parents' survival; and (3) the instinct which impels the offspring to imitate the parent, and so acquire the physical and the mental traits, the traditional knowledge and ways of thinking and acting, which the latter acquired. This subject is a very interesting one, but my space is limited, and therefore I will not dilate on it, but content myself by instancing such familiar examples as the hen, the cat and the human being in proof of my statements. Each of these animals teaches its young in a different way, and the instinct of the young causes it to imitate the parent and sport in such a manner as to develop (*i. e.*, favor the acquirement of) the physical and mental characters which conduce to the survival of the individual and the race. If it be doubted that animals lower than man have traditional knowledge, which is handed from generation to generation, I have only to instance parrots of New Zealand, which have recently acquired the habit of sheep eating, and the change which soon occurs in the demeanor of the higher animals towards man when he first enters a land where he was previously unknown, *e. g.*, the Galapagos Islands. In such lands lower animals (insects, for instance), if they exhibit alarm on his first appearance, show no increase of it in subsequent generations.

Some of this traditional knowledge, especially when it is of a kind greatly to favor survival, is doubtless of vast antiquity. Of such a nature, if I am right in regarding it as an acquirement, must be the slave-making habit of certain ants, since their very physical structure has been immensely modified by it—not by the *congenital* transmission of acquired characters, but wholly by the transmission and accumulation of such inborn variations as best served the utilization of the acquired character; hence, for instance, the great jaws of *F. rufescens.* In man occur many examples of physical structures modified by the persistent acquirement, in generation after generation during long ages, of particular acquired characters. For example, his whole di-

gestive apparatus has been modified by his acquired habit of cooking or otherwise modifying his food, to which cause may even be attributed the unsoundness of the teeth of civilized man; these, since they are no longer absolutely essential to survival, having undergone retrogression as regards their power of resisting bacteria, etc. His lingual muscles have been modified by his acquired habit of speech. His slowly-acquired habit of bipedal progression has resulted in immense and obvious physical alteration. Even the acquirement of surgical knowledge, at first rudimentary, but now highly advanced, has caused at least one important modification. Animals, as a rule, bear their young easily. When any disproportion exists between the fœtal head and the maternal pelvis both mother and offspring perish and the peculiarity is not transmitted. Savage women are under much the same conditions, and give birth almost as easily as lower animals. But for ages civilized women in labor have received artificial aid; they are, therefore, nearly all incapacitated for a time after the birth of each child; indeed, the recent advance of obstetric science has enabled so many of the otherwise unfit to survive among us for some generations past that now numerous women are quite unable of parturition without instrumental aid.*

The evolution of the power of acquiring characters, mental and physical, appears to me the most important, indeed the very central fact in the evolution of all the higher animals. Beyond all other characters this has been steadily evolved by Natural Selection, and therefore the higher placed an animal is in the scale of life the more is it developed in him. Possibly some other mammals are as capable of acquiring physical characters as man; it may be that as much of the physical development they undergo after birth is due to the effects of use and exercise; but, beyond question, no other animal is mentally so receptive as man. His power of acquiring mental characters (*i. e.*, his memory) is enormous, and so greatly does he depend on it for survival that, as we have seen, his inborn mental characters (*i. e.*, his instincts), except in a few instances, have undergone complete retrogression. His mind, as I have said, is a blank at birth, and it follows, since so much is acquired, that the disposition or character of every man must be almost entirely acquired, and not inborn, as is usually assumed. Part of the contents of his memory are recognizable (*i. e.*, may be distinctly remembered), but very much, especially all that is acquired during infancy, is not so. We speak of it as 'forgotten,' but forgotten things, though they can no longer be represented in consciousness, yet leave their impress on the mind. To take an illustration: imagine twin infants in the same cot, one awake and the other asleep; suppose an event happens that alarms the waking child, but leaves the other unaffected; suppose, again, that subsequently another event, observed by both children, occurs, which, owing to the apprehension and nervous irritability engendered by the previous event, again alarms the first child, and thus increases its irritability, but, because of its previously undisturbed equanimity, again leaves the second unaffected by fear; imagine this process repeated; then, though the original cause of fear were quite forgotten, the one child might well grow up of a much more timid and

*The use of forceps was formerly very rare in midwifery practice, but is now very common. Doubtless this is mainly due to a change in fashion, the modern obstetrician, on the average, being more skilful and, therefore, more ready to use his instruments than his forebear; but, doubtless, also, it is due in part to a growing disproportion between the maternal pelvis and the fœtal head in highly civilized races. It is not possible that the saving of so many narrow-hipped women and big-headed children can have left the race unaffected.

nervous disposition than the other; in which case every one would speak of the former as *naturally* (*i. e.*, innately, instinctively) more timid than his brother, though, in fact, his excess of timidity would be acquired.

In practice, owing to the necessity of the case, we act as if we realized that man's mind, his character, his disposition, is almost entirely acquired; and, therefore, every parent carefully trains his child for a prolonged period, striving by precept and example to inculcate fit mental traits, that is, fit knowledge and ways of thinking and acting. Even the savage mother does this, and civilized nations have vast state establishments for educating their youth. Moreover, we realize that a child reared by the brave or the cowardly, the active or slothful, the moral or the immoral, the patriotic or the non-patriotic, the devout or the sceptical, and so forth, will exhibit the traits of his educators, even if they be not his progenitors. In fact, we realize, as regards man (though this is not true as regards such animals as the dragon-fly, in which, as we have seen, the mentally acquired is practically non-existent), that the mind of one generation imprints itself on the mind of the next, not racially, but educationally; but, in thinking of this or that adult man, or this or that race of men, we are apt to consider their mental peculiarities as innate and acquired. Especially is this done by men of learning, historians, anthropologists, psychologists, philosophers and the like. It is not realized by them that *man's real mental evolution has lain in the evolution of his power of acquiring mental traits*, and that not in a single other inborn peculiarity does he mentally transcend lower animals, and, therefore, that one adult individual or race must differ from another individual or race wholly in the traits that are acquired, *and in the power of acquiring them*. For example, no man or race is born with greater musical, artistic or mathematical powers than any other man or race, but merely with greater powers of acquiring them; for, in the absence of appropriate stimulation (*i. e.*, experience, education), they do not develop even in the most 'gifted.' It seems probable, moreover, that powers of acquiring these and other particular faculties have not been separately and especially evolved by Natural Selection, but, on the contrary, that they are but particular manifestations of the general power of acquiring mental traits, which is what has been evolved by Natural Selection.* Thus there appears to be no more reason for supposing that the mathematical faculty has been especially evolved than for supposing that the faculty for understanding the uses of machinery has been evolved; both the one and the other must have been equally useless to the primitive savage.

In lower animals the amount of mental receptivity is closely associated with the size of the brain, the larger brain being the concomitant of greater receptivity, and, as a consequence, of lessened instinct. Associated with this truth is the fact that modern representatives of ancient animals (*e. g.*, ungulates) have much larger brains than their ancestors, denoting the evolution in them of the supremely important faculty of acquiring mental characters. Now, since so little that is mental is inborn in man while so much is acquired, we must conclude that differences in the sizes and shapes of the brains of different races imply not inborn mental differences, but differences in the power of acquiring mental characters, and, therefore, for example, that the native Australian, with his small

* Of course, I do not mean by this that the man who is capable, for instance, of high musical attainments, is also necessarily capable of high mathematical attainments. We know that this is not so. Nevertheless, even as regards these faculties much must depend on the 'bent' given to the individual's mind by circumstances occurring early in life.

brain, differs from the Chinaman or Japanese, with his large brain, not mainly in that which is mentally inborn, but mainly in that he has lesser power of acquiring complex mental characters. If this is true, and there is a mass of evidence proving that it is true, for children of one race reared by another and very different race develop the mental features of their educators, not of their progenitors (*e. g.*, Europeans reared by savages or savages reared by Europeans),* then much of the reasoning of numerous thinkers has been founded on false premises, and is invalid. They have commonly estimated the mental calibre of a race by the intellectual feats performed by it, but plainly these are wrong criteria, since whether these feats be great or small depends almost entirely on the environment, that is, on education. A South Sea Islander, for instance, would, and could, do nothing in his ancestral environment compared to what he would be intellectually capable of were he during early life transferred and trained in the midst of a learned and scientific society.

In discussing this subject one is embarrassed by the wealth of the material that presents itself for criticism. In the lightest, as in the weightiest literature, it is constantly assumed that various racial peculiarities and differences which are manifestly acquired are inborn—that this or that race is inherently brave or resolute, or enterprising, or industrious, or gifted with a genius for colonization or empire, while this or that other race is timid, or irresolute, or indolent, or servile, and so forth. To illustrate my remarks and conclude my essay I may cull a few examples from an enormous field. Dr. Francis Galton says: "The importance to be attached to race is a question that deserves a far larger measure of exact investigation than it receives. We are exceedingly ignorant of the respective ranges of the natural and acquired faculties in different races; and there is too great a tendency among writers to dogmatize wildly about them, some grossly magnifying, others as greatly minimizing their several provinces. It seems, however, possible to answer this question unambiguously, difficult as it is."* But, if I am right, as I think I am, in the foregoing, surely *every* writer has too greatly exalted the importance of the inborn and too much minimized the importance of the acquired factor in man. Does not Dr. Galton himself exalt vastly too much the importance of the inborn factor, as witness the following passage, which, in this respect, is similar to many others in his work:

"The long period of the Dark Ages, under which Europe has lain, is due, I believe, in a very considerable degree, to the celibacy enjoined by religious orders on their votaries. Whenever a man or woman was possessed of a gentle nature that fitted him or her to deeds of charity, to meditation, to literature or to art, the social condition of the time was such that they had no refuge elsewhere than in the bosom of the Church. But the Church chose to preach and exact celibacy. The consequence was that these gentle natures had no continuance, and thus, by a policy so singularly unwise and suicidal that I am hardly able to speak of it without impatience, the Church brutalized the breed of our forefathers. She acted precisely as if she had aimed at selecting the rudest portion of the community to be, alone, the parents of future generations. She practiced the arts which breeders would use, who aimed at creating ferocious, currish and stupid natures. No wonder that club law prevailed for centuries over Europe; the wonder rather is that enough

* Consider, for instance, how different in either case would be the contents of memory and all that arises out of memory.

* 'Hereditary Genius,' preface to edition of 1892, p. xxv.

good remained in the veins of Europeans to enable their race to rise to its present, very moderate, level of natural morality." * Dr. Galton implies that a tendency to charity, meditation or to the cultivation of literature is an inborn and transmissible character, whereas they are, in fact, acquired. A Quaker's child, for example, reared by North American or West African savages shows none of the gentle altruistic nature of his progenitors, and obviously shows no literary tendencies. The child of a bloodthirsty and immoral savage may be made sanctimonious to an even unpleasant degree, as has happened under the influence of missionaries in certain Polynesian islands, where by act of the native legislature flirtation is now a legal offence. The children of aborigines have done exceedingly well, as compared to Europeans, in the Australian government schools. The Church, therefore, may have brutalized society in the Dark Ages, by its influence on the characters acquired by the individuals comprising it; for instance, by inculcating celibacy it may have prevented people who had acquired the best characters from having families, and so passing on their acquired excellencies, like language or even property, to descendants. But since mere chance, not innate tendencies, must have determined in each case the inclination or disinclination towards charity, etc., the Church cannot have selectod any *particular type*, and therefore cannot have caused real evolution or retrogression.

It is, of course, impossible for obvious reasons to prove of a particular person with (for instance) charitable inclinations that in a different environment he would have acquired different inclinations. But what cannot be proved of the individual can be proved of the race, which is but an aggregate of individuals. If my definitions are correct, innate inclinations or tendencies are of the nature of instincts, and these can arise only very slowly under the prolonged action of Natural Selection, and, if they disappear, can do so only equally slowly after cessation of selection. But consider how rapidly a race (*e. g.*, the Japanese) may change its characteristics. Consider, in particular, the enormous change, as expressed in the resultant civilization, which occurs in the character of a race when it changes its religion. Compare the mental characters of the races of Asia Minor and North Africa as they changed successively from Pagan to Christian and from Christian to Mohammedan. Consider how much Pagan, Mohammedan and Christian negroes differ in their mental characters. Consider how closely Mohammedans of all races resemble one another mentally. Consider how indistinguishable mentally are Catholic Teutons from Catholic Celts in Ireland, and how markedly they differ both from the Protestant Teutons and the Protestant Celts of Great Britain. I have, however, dealt somewhat fully with this matter of religion elsewhere,* and my space here is limited. Still I am in hopes that the little I have said proves that any tendency towards charity, etc., is wholly acquired and not inborn.

Again Galton says: "The ablest race of which history bears record is unquestionably the ancient Greek, partly because their masterpieces in the principal departments of intellectual activity are still unsurpassed, and in many respects unequalled, and partly because the population that gave birth to the creators of those masterpieces was very small. Of the various Greek sub-races, that of Attica was the ablest."† He further says: "The average ability of the Athenian race is, on the lowest possible estimate, nearly two grades higher than our own—that is, about as

*Ibid, p. 343, 344.

* 'The Present Evolution of Man,' p. 188–196.

† 'Hereditary Genius,' p. 329.

much as our race is above that of the African Negro. This estimate, which may seem prodigous to some, is confirmed by the quick intelligence and high culture of the Athenian commonalty, before whom literary works were recited and works of art exhibited, of a far more severe character than could possibly be appreciated by the average of our race, the calibre of whose intellect is easily gauged by a glance at the contents of a railway book-stall."* De Quatrefage says: "There can be no real relation between the dimensions of the cranial capacity and social development." * * * "By such an extension the Troglodytes of the Cavern of L'Homme-Mort would be superior to all the races enumerated in the table, including contemporary Parisians."† But Mill wrote: "Of all vulgar modes of escaping from the consideration of the effect of social and moral influences on the mind, the most vulgar is that of attributing the diversities of conduct and character to inherent natural differences;"‡ and Buckle, the historian, who, notwithstanding the deficient knowledge of his time, had a true appreciation of the problem, said: "Whatever, therefore, the moral and intellectual progress of men may be, it resolves itself, not into a progress of natural capacity, but into a progress, if I may say so, of opportunity, that is, an improvement in the circumstances under which that capacity after birth comes into play. Here, then, lies the gist of the whole matter. The progress is one not of internal power, but of external advantage. The child born in a civilized land is not likely as such to be superior to one born among barbarians, and the difference which ensues between the acts of the two children will be caused, so far as we know, solely by the pressure of external circumstances, by which I mean the surrounding opinions, knowledge, associations, in a word, the entire mental atmosphere in which the two children are respectively nurtured."*

* Ibid, p. 330–331.

† 'The Human Species.'

‡ Mill's Principles of Political Economy, Vol. I., p. 390.

Mill and Buckle, though unacquainted with the doctrine of evolution, were surely right. The ancient Greeks and Romans were certainly of extraordinary mental prowess, but it is more than probable that they surpassed our more remote ancestors only because the environment in which they lived was more favorable than the mediæval to the acquirement of fit mental traits; because, in their free, intellectual atmosphere, they were trained to the performance of intellectual feats, which were impossible to the fettered minds of our forefathers, who could hardly achieve greatness, except as priests or warriors, or as painters, sculptors, architects, musicians, or as other laborers in such arts as served the grandeur of the Church or the Throne. The splendor of the Greek and Roman achievements, therefore, does not constitute a proof that the Greeks and Romans were splendidly endowed, but only that the traits which they acquired from their progenitors enabled them to use their endowments splendidly. In judging of the mental capabilities of a people as a whole, as in judging of physical powers, it is safer to take as a test their corporal structures, their bodies and brains, rather than their physical and mental feats, for whether these latter be great or little depends on circumstances which may be favorable or the reverse. Had the Troglodytes received the same mental training as the Greeks it is possible or probable, since their brains were large, that they would have performed feats intellectually as great, but had Aristotle or Plato received the training of the cave-men great feats would have been impossible to them. They would have died

* Buckle's History of Civilization, Vol. I., p. 178.

unknown to fame. Moreover, such feats as were performed by the Greeks would not have been recognized as great among prehistoric peoples, and such intellectual giants, but physical weaklings, of the modern world as Darwin and Spencer would have earned, and in that state of society deserved, the contempt of their fellows.

Mr. Herbert Spencer attributes much of the contents of man's mind to the transmission and accumulation of acquired mental characters. Thus he attributes the altruistic feelings to this cause and anticipates a happy future for many by their continued increase. Mr. B. Kidd, whom I confess I have a little difficulty in taking seriously, on the other hand, attributes these feelings to Natural Selection. He is very severe on Mr. Herbert Spencer and writes: "The confusion of ideas to which the tendencies of the times give rise finds remarkable expression in Mr. Herbert Spencer's writings."* The tendencies of the time seem to have confused Mr. Kidd's own ideas to an even greater extent, and it would have been well had he harkened to Mr. Spencer's warning against thinking in abstract terms.†

As already indicated in this JOURNAL,‡ Natural Selection implies elimination of the unfittest, and Mr. Kidd has failed to record a single death as due to the absence of this feeling in him who perished, and the presence of it in him who survived. Having regard to the foregoing, is it not abundantly evident that the altruistic feelings have not undergone evolution at all in man, neither by the transmission of inborn characters nor that of acquired characters? As I say the child of a philanthropist if reared by West African savages might well be a fiend in cruelty, he certainly would have no philanthropic tendencies as we understand them; the child of a cannibal, properly trained, might well develop into a philanthropist; and surely that which may be entirely lapsed or developed in a single generation cannot properly be regarded as a direct product of evolution. Like patriotism, or devotion to a particular religious system, or a knowledge of language, or of letters, or of the uses of steam, or of the bicycle, the altruistic feelings are purely acquired (and not transmissible), and are not immediate products of evolution, but result indirectly from the evolution of man's mental receptivity, that is, from the evolution of his vast power of acquiring mental characters. Men in various times and places have been *taught* to worship sticks and stones, and to hold in reverence all kinds of absurd beliefs and notions, so also a child—any child—by fit training may be rendered highly altruistic—may be taught to receive and practice altruism, as he may be taught to reverence and practice fetishism; whence it follows, as a logical conclusion, that in every individual the altruistic feelings are purely acquired. It matters not that, in a greater or less degree, they are universal. So is knowledge of language and religion, which, though universal, is as much acquired as is a knowledge of history or of astronomy. If, then, in the ancestry of man, these feelings were ever instinctive, as we may suppose them to be among bees, this instinct, like almost all others, was lapsed long ago, and was replaced by an acquired character.* We need not await, then, the slow evolution of the social millenium by the accumulation of inborn altruistic variations, as Mr. Kidd expects, nor by the accumulation (and transmission) of acquired variations, as Mr. Spencer expects. Were we all agreed

* 'Social Evolution,' p. 158.

† 'The Inadequacy of Natural Selection,' p. 67.

‡ September 11, 1897, p. 371.

*I cannot here pause to discuss the cause of the retrogression of instinct. But I have dealt at length with the cause of the retrogression of physical parts in my book, and that of the retrogression of instinct follows the same law. An outline of the theory was given in SCIENCE of September 3, 1896.

as to the training of our children it would be achievable in the very next generation, for surely, if a generation can be reared to reverence a stick or a stone, an inanimate idol, and this or that grotesque religious system, it can be reared also to love and reverence man.

One paragraph more and I have done. We hear of the evolution of morals or of language or of religion, of the printing press, of the locomotive, of the bicycle, and so forth. In the popular mind, and, I fear, even in the minds of some scientific men, this evolution ranks as a process of the same order as the evolution of a plant or animal. Evolution means unfolding, and, therefore, the word is perhaps correctly applied to the bicycle, etc. But there is this essential difference between a living being and the bicycle: The former is the progeny of a parent; the latter is not. So also the language of to-day is in a figurative sense only the progeny of the language of the former times; the morals of to-day have, in a figurative sense only, descended from those of yesterday. All these things are human inventions, and belong not to human evolution, but to what has been called evolution in the environment. The so-called 'Social Evolution,' of which we have lately heard so much, is therefore a myth from the biological standpoint. As I have said, and as I wish to iterate and reiterate, neither the altruistic feelings in particular, nor morals in general, nor anything of the kind, has undergone evolution in man. What has undergone evolution is his enormous power of acquiring characters, these among others. G. ARCHDALL REID.

SOUTHSEA, ENGLAND.

SOME RECENT OBSERVATIONS ON THE INFLUENCE OF THE THYROID GLAND ON METABOLISM.

IN an article by Professor Chittenden, published in SCIENCE, June 25th, a summary is given of what was then known regarding the influence of the thyroid gland on metabolism. Since that time a valuable contribution to our knowledge has come from Bernhard Schöndorff, published in Pflüger's Archiv für Physiologie (Band 67, p. 395). He finds that, contrary to previously received notions, the feeding of thyroid glands or iodothyrin to an animal does not invariably stimulate proteid metabolism. Further he finds that the loss of weight so often observed under such treatment is due mainly to an increased combustion of the body-fats, and that the increased excretion of nitrogen through the urine observed by Voit and others is not necessarily due to an increased proteid metabolism, but to an increase in the excretion of urea and allied bodies which are known to exist pre-formed in the tissues in considerable quantities.

The investigation was carried out on a dog of 55 pounds weight. It was kept in a suitable cage, and its food so regulated that under ordinary conditions the animal remained at a constant weight and in nitrogenous equilibrium. The thyroids were administered for the most part in the form of dry tablets prepared by Borroughs, Wellcome & Co., of London, but sometimes fresh or dried sheep's thyroids were given either alone or with the tablets. At first the dosage was ten of these tablets administered with the daily food. Within a few hours the animal's weight began to fall, and at the end of twenty-three days it had lost nearly two and a half pounds. During the first eight days the nitrogen also showed a minus balance; that given off in the urine and feces amounted to 32 grams, while the food contained only 31 grams. During the next fifteen days, however, there was a plus balance. Evidently these results point to a largely increased consumption and elimination of non-nitrogenous material, and in the light of previous researches Schöndorff attributes them to an increased combustion

of the fats. But they throw very little light upon the proteid metabolism.

For the succeeding twenty-four days the dosage was raised to twenty tablets a day. The effect was unmistakable. The nitrogen eliminated was 4% in excess of that contained in the food. The loss of weight amounted to 2.25 kilos, or nearly five pounds, and at the close of the period the animal was so thin that its ribs and pelvic bones showed plainly. When, however, the nitrogen loss (in all 30 grams) is multiplied by the figure 30, which Pflüger has shown to represent the ratio between the proteid tissues and their nitrogen content, it is evident that the albuminous waste can account for only three-sevenths of the total loss of weight. The other four-sevenths (in all three pounds) must have come from the fats, which implies an increase of combustion to the extent of 43%. The violent panting of the animal points to the same conclusion; while the loss of nitrogen shows that, just as is the case during prolonged hunger, when the supply of fat has been reduced to a certain limit, the system falls back upon its proteids to meet the demands caused by iodothyrin.

At this point the administration of thyroid tablets was stopped, and contrary to the statements of some observers, that iodothyrin has a considerable after-effect, the nitrogen balance became positive immediately and the body weight increased rapidly.

When the animal had again attained its normal weight, the investigation was repeated. Twenty tablets a day were administered. The animal's weight fell a pound a week. For the first few days the nitrogen in the excreta exceeded that in the food by 8%. But the daily analyses showed that by the twelfth day nitrogen demand and supply were again in equilibrium.

At the end of two months, however, the weight ceased to fall. The tablets were discontinued for a week, and the weight rose one and a half pounds. On administering the tablets again for two weeks the weight fell one and a half pounds, but the nitrogen maintained a steady plus balance.

From these facts Schöndorff concludes that in the case of an animal at a uniform weight and in nitrogenous equilibrium iodothyrin causes an increase of combustion and a consequent loss of weight. So long as the store of fat is above a certain limit proteid metabolism, however, remains unaffected; the temporary minus balance of the body's nitrogen is due to an increased elimination of urea and similar substances which existed pre-formed in the tissues; but when the fats have been reduced below a certain limit the proteids are likewise attacked. Throughout his investigations, however, Schöndorff assigns all the effects produced to the iodothyrin contained in the ingested thyroids. He accepts the prevailing opinion of physiologists, that the iodothyrin isolated by Baumann is the full physiological equivalent of the gland, and at no time during the research was the pure substance administered in place of the glands. Yet experiments by Dr. Edm. Wormser, published in a later number of Pflüger's Archiv (Band 67, p. 505), seem to show that the thyroid itself or an aqueous extract of the gland possesses a physiological activity (at least when fed to animals whose thyroids have been removed) far in excess of that exhibited by pure iodothyrin. Similar results have been obtained by A. Schiff, who has been working at this question simultaneously, though quite independently. (Wiener Klin. Wochenschr. 1897, p. 277.) Schiff, however, states that different preparations of iodothyrin vary considerably in the extent of influence they exert, but he asserts that no preparation shows a physiological activity at all comparable to that of the gland itself. If later researches verify these observations they

will prove that, as Wormser claims, iodothyrin is not the only active body secreted by the thyroid, but that some other substance must act with it in order to perform all the functions of the gland.

Wormser's experiments were carried out upon dogs whose thyroids had been carefully removed. The animals were fed with various preparations made from thyroids as well as such artificial compounds as sodium iodide and iodo-casein, and the influence of these substances, in preventing or lessening the tetanus and other symptoms resulting from the operation, was noted.

The first animal experimented upon was fed with dry thyroids for twenty days after the thyroidectomy, and during this time its condition showed nothing abnormal. On the twenty-first day the dry thyroids were replaced by iodothyrin in such quantity that the iodine content equaled that of the previously administered glands. Two days later the animal was seized by a violent tetanus. The dry thyroids were again administered, and the dog recovered in a few hours. The glands were again replaced by iodothyrin, and the animal died within thirty-six hours. This experiment was repeated three times with iodothyrin prepared from sheep and pigs by both of Baumann's methods, and the results agreed perfectly.

Iodo-casein, an artificial compound, has been found efficacious in reducing the size of a goitre. When this substance was administered to dogs whose thyroids had been removed, the intensity of the tetanus seemed to be reduced, but death nevertheless ensued. Similar experiments were tried with sodium iodide, and with the albuminous material precipitated from a sodium chloride extract of the thyroid gland by acetic acid. These results, however, were entirely negative.

Wormser notes, however, that throughout these investigations he found young animals far more susceptible to the evil effects of thyroidectomy than fully mature or old animals, while the appearance of tetanus and other symptoms was delayed by a milk diet, but hastened by one largely composed of meat.

Finally, in summing up the results of his experiments, Wormser points out that the thyroid itself or an aqueous extract of the gland is far more potent physiologically than any substance yet isolated from the gland or artificially prepared, and that therefore no one substance can account for all the functions of the thyroid.

YANDELL HENDERSON.

THE ENZYMIC FERMENTS IN PLANT PHYSIOLOGY.

FERMENTATION, as a general term, covers many of the most important processes in chemistry. Fermentations are of many particular kinds, each depending more or less distinctly upon some specific ferment agent. This makes it convenient to classify the fermentation processes according to the correlated ferment agents. Thus we have yeast fermentation, bacterial fermentation, enzymic fermentation and the like.

The ferment agents, and, following them, the fermentation processes, may be roughly thrown into three classes: (1) Those belonging to the lower orders of fungi, like yeast. (2) Bacteria, like those present in the 'mother' of vinegar, or in the souring of milk. These two classes are often called organic ferments in distinction from the next. (3) Unorganized, or soluble ferments, or enzyms, like diastase, pepsin and ptyalin. The knowledge of these enzyms is mostly of very recent development, and is still fragmentary and generally unsatisfying. They have been best known as they occur in the animal digestive juices. The students of animal physiology have been used for some years to point out the presence of ptyalin and diastase in saliva, of pepsin and trypsin in the gastric juice, and

of pancreatin, trypsin and diastase in the pancreatic secretions. And in a very hazy sort of way it has been known for a considerable time that the same and similar ferments are active in the physiological processes of plants. In very recent years the sharp press of experiment upon all phases of plant economy has brought to light many facts of almost startling interest. We may reasonably hope to collect observations enough within a few years to make generalization practicable; but up to the present we are doing fairly well to get some detached notions of certain of these enzyms, of their nature and action, and their relation to important vegetation processes.

The certain determination, even qualitatively, of all the enzyms present in any given part of a plant can hardly be safely made in any case; but it is known that various enzyms are present in nearly all the living organs. Each plant—especially among the flowering plants—takes up quantities of food materials, which it circulates, digests, stores, unstores, circulates again, assimilates, breaks down and finally, perhaps, excretes. In all the multifarious processes of digestion and redigestion the enzyms may take prominent part. They are almost always found in connection with special food storages, as in buds, tubers, bulbs and seeds.

Before a healthy deciduous woody plant enters upon its period of rest it stores up a considerable quantity of food with which to begin work again in the spring. These storages are largely of starch, and may be demonstrated by the iodine stain under a lens in the woody tissues of stems, especially near buds, or in the roots. The regions of fruit buds in such plants as apple and plum commonly show remarkable storages of this sort. With returning spring, before the roots start or before the leaves are put out to capture and digest food, these stores of starch and other materials are put in motion once more, and from them the new leaves are built or the early blossoms pushed forth. Theoretically and from experiment we are led to believe that these early redigestive processes are dependent on certain enzymic ferments.

In a quite similar manner those plants which propagate their species by means of tubers or bulbs store quantities of food in such organs which later can be reabsorbed and used to start the young plantlet. The recent remarkable results reported by Johanssen before the Agricultural High School of Copenhagen, and so liberally noticed in the public prints of America, were brought about by the application of ether fumes to secure an early liberation of these stores of food in bulbs and dormant woody plants.

Seeds act in the same way. When perfectly ripe and viable seeds are brought into conditions favorable to germination, the relatively large stores of food which they contain are released for the use of the nascent plant. In this case the activity of diastasic ferments is comparatively well known. Perhaps other enzyms are also present and active. The chief commercial source of diastase, in fact, is malt, that is, grain taken at the height of the germination activities. It has been often observed that seeds do not germinate well if planted immediately after ripening; that a period of rest increases the promptness and vigor of germination; and it has been thought probable that this period of rest is useful in allowing the accumulation of the necessary enzymic ferments.

One of the facts of commonest knowledge is that seeds deteriorate in viability when kept for some time. The period at which all the seeds of a sample lose their power of germination varies from two to twenty years or more, but most garden seeds deteriorate rapidly after they are three years of age. It has seemed probable that this

reduction in viability is due to the diminution in quantity or loss in quality of the enzyms in the seeds. Some very interesting experiments made in the experiment station of the University of Vermont tend to establish this theory, as well as to offer some applications of practical value. Various old seeds were treated with different enzym solutions and were then placed in suitable apparatus for germination. One lot of tomato seeds, twelve years old, soaked for twenty-four hours before germination, gave the following results:

Soaked in water,..........	28 per cent	germinated.
Soaked in trypsin,........	56 "	"
Soaked in Extractum pancreatis..................	36 "	"
Soaked in Enzymol, ...	52 "	"

Another lot of seeds of another variety of tomato, twelve years old, gave these results:

Soaked in water,...........	34 per cent.	germinated.
Soaked in diastase, ...	70 "	"

One of the most remarkable experiments was with another lot of tomato seeds, also twelve years old. The result stood:

Soaked in water,...........	12 per cent.	germinated.
Soaked in pepsin, ...	80 "	"
Soaked in diastase, ...	85 "	"

This shows an increase of 567 per cent. and 608 per cent. respectively in the germination through the action of the enzyms artificially supplied. Other seeds of other species and other enzymic preparations gave similar results.

In view of our present knowledge it seems quite fair to hope that, when we understand better the enzyms and their relation to the processes of vegetable physiology, we shall be able to control to our advantage many of the critical steps in plant development.

FRANK ALBERT WAUGH.
UNIVERSITY OF VERMONT.

CURRENT NOTES ON ANTHROPOLOGY.

THE OLDEST CRANIA FROM CENTRAL MEXICO.

IN his work, 'Anthropologie du Mexique,' published in 1884, Professor Hamy gave the measurements of a number of skulls obtained from sepultures of uncommon depths in various parts of central Mexico. Those at Tlaltelolco were from seven to eight feet below the surface and appeared to date from a remote antiquity. These skulls were all characterized by marked brachycephaly, with indices of 85 and upward.

In the *Bulletin du Museum d' Histoire Naturelle*, 1897, No. 6, the same author reports the measurements of five skulls from very ancient burial sites in the district of Colotlan, State of Jalisco. The cranial capacity is good (male 1485, female 1280), but all five of them were remarkably brachycephalic, the average being above 86, and the highest reaching 92.40!

The modern graves, on the other hand, yield skulls which are distinctly dolichocephalic, and the present native population is of this character. They are the Guicholas, speaking a dialect of Nahuatl. They assert that these older graves are not those of their ancestors, but of another race; and the difference in the art-remains substantiates this tradition. Professor Hamy concludes that all the oldest tribes of central Mexico were broad-skulled, with marked alveolar prognathism.

THE OLD LAND-BRIDGE TO EUROPE.

IN the introduction to my 'American Race' I pointed out the arguments for the existence of a land-bridge from North America to Europe in pleistocene times, across which the ancestors of the American man might have journeyed. Since the publication of that work a number of writers have advocated this hypothesis, as Georges Hervé, Charles Tissot, M. Lapparent, etc. The latest is M. Philippe Salmon, ex-President of the Anthropological Society of Paris.

In a paper in the *Revue Mensuelle* of the Paris School of Anthropology, for September, he undertakes to locate the period of the final disruption of the two continents more accurately than heretofore.

He carefully considers the pleistocene fauna of both areas, compares the states of the earliest arts, and especially lays stress on the time and manner of the disappearance of the reindeer in France, and the sudden change of climate from arctic to temperate conditions which that indicates. The cause of this change was the altered direction of the current of the Gulf Stream owing to subsidence of the land areas. His article entitled 'L'Atlantide et le Renne' will be found highly suggestive.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

SCIENTIFIC NOTES AND NEWS.

AMERICAN MATHEMATICAL SOCIETY.

THE annual meeting of the American Mathematical Society will be held on Wednesday, December 29th, in Room 301 of the Physics Building of Columbia University, New York City. In accordance with the provisions of the constitution of the Society, the annual election of officers will be held at this meeting, and a presidential address, 'On the Philosophy of Hyperspace,' will be delivered by President Simon Newcomb. The sessions will begin at 10:30 a. m. and 2:30 p. m., and the Council will meet at 2 p. m.

The following is a list of papers thus far entered for presentation at the meeting:

Morning Session.

(1) 'On the differential equations defining the Laplacian distribution of density, pressure and acceleration of gravity in the earth,' PROFESSOR R. S. WOODWARD, Columbia University; (2) 'The theorems of oscillation of Sturm and Klein,' PROFESSOR MAXIME BÔCHER, Harvard University; (3) 'On some points in the theory of functions,' PROFESSOR A. S. CHESSIN, Johns Hopkins University; (4) 'Point transformation in elliptic coördinates of circles having double contact with a conic,' DR. EDGAR ODELL LOVETT, Princeton University,' (5) 'Certain invariants of a plane quadrangle by projective transformation,' DR. EDGAR ODELL LOVETT, Princeton University.

Afternoon Session.

(6) Presidential address: 'The philosophy of hyperspace,' President SIMON NEWCOMB, Washington, D. C.; (7) 'Limits of transitivity of substitution groups,' DR. G. A. MILLER, Chicago, Ill.; (8) Some theorems in n-dimensional space,' MR. C. J. KEYSER, Columbia University; (9) 'The orthogonal group in a Galois field,' DR. L. E. DICKSON, University of California.

The Chicago Section of the Society will hold its second meeting on Thursday and Friday, December 30th and 31st, at Northwestern University, Evanston, Ill. Regular meetings of the Society will be held in New York on February 26th and April 30, 1898. The summer meeting will be held next year at Boston, Mass., in connection with the meeting of the American Association for the Advancement of Science.

The membership of the Society now exceeds 300. The November number of the *Bulletin* (Vol. VII., No. 2) contains, besides the 'Notes' and 'List of New Publications,' an account of the International Congress of Mathematicians held at Zürich last August; a report by the Secretary, Professor James McMahon, of the proceedings of Section A at the Detroit meeting of the American Association for the Advancement of Science; 'Quaternions as Numbers of Four Dimensional Space,' by Professor Arthur S. Hathaway; 'Note on the Invariants of n Points,' by Dr. Edgar Odell Lovett; 'Note on the Fundamental Theorem of Lie's Theory of Continuous Groups,' by Dr. Edgar Odell Lovett; 'A Geometrical Locus Connected with a System of Coaxial Circles,' by Professor Thomas F. Holgate; 'Condition that the Line Common to N—1 Planes in an N Space may Pierce a Given Quadric Surface in the Same Space,' by Dr. Virgil Snyder, and a review of Lamb's *Hydrodynamics* by Professor Ernest W. Brown.

The December number of the *Bulletin* (Vol. VII., No. 3), which has just appeared, contains an account of the October meeting of the Society, by the Secretary; 'Note on Hyperel-

liptic Integrals,' by Professor A. S. Chessin; 'Certain Classes of Point Transformations in the Plane,' by Dr. Edgar Odell Lovett; 'Continuous Groups of Circular Transformations,' by Professor H. B. Newson; a review of Plücker's *Collected Papers*, by Professor Charlotte Angas Scott, and 'Notes' and 'New Publications.'

THE AMERICAN SOCIETY OF NATURALISTS AND AFFILIATED SCIENTIFIC SOCIETIES.

THERE is every indication that there will be an unusually full attendance at the Ithaca meeting beginning on Tuesday of next week. The following is a list, revised to December 21st, of those who have already signified their intention of being present.

New York City and Columbia University: Dr. H. F. Osborn, Dr. E. B. Wilson, Dr. G. S. Huntington, Dr. F. S. Lee, Dr. J. McK. Cattell, Dr. S. J. Meltzer, Dr. L. Farrand, Dr. J. A. Blake, Dr. R. Hunt, Mr. N. R. Harrington, Mr. H. E. Crampton, Jr., Dr. Franz Boas, Mr. C. A. Strong, Mr. S. I. Franz, Professor L. M. Underwood, Mr. Lloyd, Dr. C. L. Bristol, Brother Chrysostom.

Harvard University: Dr. G. H. Parker, Dr. G. W. Fitz, Dr. H. M. Richards, Dr. C. B. Davenport, Dr. C. R. Eastman, Miss Ida H. Hyde, Dr. H. P. Bowditch, Professor Chas. S. Minot, Professor W. T. Porter, Professor Josiah Royce.

Philadelphia and University of Pennsylvania: Dr. E. G. Conklin, Dr. J. M. Macfarlane, Dr. John W. Harshberger, Dr. Adeline F. Schively, Dr. Martha Bunting, Dr. Hobart C. Porter, Miss Caroline Thompson, Dr. A. P. Brubaker, Professor G. S. Fullerton.

New Haven and Yale University: Professor W. H. Brewer, Professor R. H. Chittenden, Dr. W. C. Sturgis, Professor L. B. Mendel, Professor Graham Lusk, Professor Herbert E. Smith, Dr. A. W. Evans, Dr. H. B. Ferris.

Baltimore and Johns Hopkins University: Dr. E. A. Andrews, Dr. Ross Granville Harrison, Dr. F. P. Mall, Mr. Charles W. Green, Dr. W. H. Howell, Dr. M. M. Metcalf, Mrs. Christine L. Franklin, Professor E. H. Griffin, Mr. G. Lefevre.

Brown University: Dr. A. D. Mead, Mr. F. P. Gorham, Miss A. G. Wing, Dr. W. G. Everett, Dr. E. B. Delabarre, Dr. H. C. Bumpus.

Princeton University: Professor A. T. Ormond, Professor H. C. Warren, Professor J. G. Hibben, Professor J. Mark Baldwin, Dr. M. W. Urban, Professor William Libbey, Dr. W. M. Rankin.

Washington: Dr. Frank Baker, Professor D. S. Lamb, Dr. W J McGee, Dr. A. McDonald, Professor Chas. W. Stiles.

University of Chicago: Professor C. O. Whitman, Professor Jacques Loeb.

University of Michigan: Dr. J. P. McMurrich, Dr. F. R. Lillie, Dr. W. P. Lombard, Professor J. E. Reighard.

Smith College: Dr. H. H. Wilder, Dr. W. F. Ganong, Dr. W. C. Smith.

McGill University: Professor D. P. Penhallow, Professor E. W. McBride.

Wellesley College: Professor Clara E. Cummings, Dr. Grace C. Cooley.

Middlebury College and University of Vermont: Pro fessor E. A. Burt, Professor D. Irons.

Williams College: Professor S. F. Clarke, Professor J. I. Peck.

Massachusetts Institute of Technology: Dr. R. P. Bigelow, Dr. Theodore Hough.

Syracuse University: Professor C. W. Hargitt, Dr. G. P. Clark.

Tokyo: Professor K. Mitsukuri.

Amherst College: Dr. G. E. Stone.

Rutgers College: Professor John B. Smith.

Clark University: Dr. C. F. Hodge.

Adelbert College: Dr. F. H. Herrick.

University of Wisconsin: Dr. Joseph Jastrow.

Northwestern University: Dr. William A. Locy.

Rhode Island College: Dr. Geo. W. Field.

Union College: Dr. Chas. S. Prosser.

Bryn Mawr College: Dr. T. H. Morgan.

University of Indiana: Professor C. H. Eigenmann.

Wesleyan University: Dr. C. H. Judd.

Allegheny College: Dr. E. L. Rice.

Dartmouth College: Dr. Wm. Patten.

Missouri Botanical Garden: Professor Wm. Trelease.

GENERAL.

IT has for some time been known that Senator Elkins, the 'boss' of the Republican party organization in West Virginia, has been urging the President to appoint as Fish Commissioner a person named Bowers, from Martinsburg, W. Va. The daily papers now contain the statement that this appointment has been definitely settled. The papers consequently charge the President with intending to break the law, which is explicit in regard to the qualifications for the office. We have recently expressed our opinion as to the value and reasonableness of the law, and have every reason to believe that the President would not wish to have it altered. That he should break the law is incredible

IT is expected that the American Society of Naturalists and the affiliated scientific societies meeting at Ithaca will accept an invitation to

meet next year in New York. It is hoped that the Geological Society, at the approaching Montreal meeting, will also decide to hold its next winter meeting in New York.

THE ninth annual meeting of the American Folk-Lore Society will be held at the Johns Hopkins University, Baltimore, on December 28th and 29th.

THE chair in the section of chemistry of the Paris Academy of Sciences, vacant through the death of M. Schützenberger, has been filled by the election of M. Ditte, professor of chemistry at the Sorbonne.

DR. NANSEN will sail from New York on February 19th, and will return directly to Christiania.

PROFESSOR E. JADERAN has proposed to the Swedish Academy of Sciences that an expedition be sent next summer to Spitzbergen to make preparations for the measurement of a degree of latitude in the polar regions. It is then proposed that Russia should be invited to coöperate in the final measurement of a degree in 1899 and 1900.

WE learn from *Nature* that the French government, through its embassy in London, has presented to Sir Archibald Geikie a handsome vase of Sèvres porcelain in recognition of the services rendered by him to the Geological Survey of France.

ACCORDING to the recently published proceedings of the German Zoological Society it contains 205 members, of whom only one, Professor Leuckhart, of Leipzig, is an honorary member.

MR. V. H. BLACKMAN, Hutchinson Research Student of St. John's College, Cambridge University, and Mr. W. Morley Fletcher, Fellow of Trinity College, have gained the Walsingham Medals for biological research.

A COMMITTEE has drawn up a memorial to be presented to the New York Park Board, suggesting that the services of the late William A. Stiles be commemorated by giving his name to one of the newly projected parks in the city.

THE death is announced of Dr. Anthony Brownless, Chancellor of Melbourne University and founder of the medical school of the University, and a distinguished physician and man of science.

MR. JAMES BATEMAN, the botanist and horticulturist, died at Worthing, England, on November 27th, aged 86 years. He was one of the large group of Englishmen of wealth and leisure to whom science in Great Britain is so greatly indebted. In 1833 he sent the collector Colley to Demerara and Berbice to collect plants, and procured many orchids from Guatemala and elsewhere. In 1837 Mr. Bateman commenced the publication of his work on the 'Orchidaceæ of Mexico and Guatemala,' which he completed in 1843; this book, in atlas folio, comprised the most remarkable series of colored plates which had up to that time appeared, each of the plates costing over £200. His 'Monograph of Odontoglossum' appeared between 1864 and 1870.

DR. VON MARZ has presented to the Munich Academy of Sciences the original spectrometer of Fraunhofer, together with his prisms and his manuscripts. As an acknowledgment of this gift the Academy has conferred its gold medal on Dr. von Marz.

MR. ALFRED HARMSWORTH has loaned *The Windward*, the steamship used by the Jackson-Harmsworth expedition to Franz Josef Land, to Lieutenant Peary for his expedition next year.

A RESOLUTION has been introduced in the House of Representatives appropriating $20,000 for the representation of the United States at the International Fisheries Exposition to be held at Bergen, Norway, from May to September of next year.

THE bill passed by Congress prohibiting pelagic sealing by citizens of the United States contains a provision as follows: Section 9. That the importation into the United States, by any person whatsoever, of fur-seal skins taken in the waters mentioned in this act, whether raw, dressed, dyed or manufactured, is hereby prohibited, and all such articles imported after this act shall take effect shall not be permitted to be exported, but shall be seized and destroyed by the proper officers of the United States.

PROFESSOR S. B. BROWN, of West Virginia University, is preparing for the State Geological

Survey Commission a bibliographical and historical sketch of all the work that has been done for the study of geology, biology and the resources of West Virginia by public and private effort.

AT a meeting of the Board of Managers of the New York Zoological Society, on December 14th, it was announced by Professor Henry F. Osborn, Chairman of the Executive Committee, that subscriptions amounting to $65,000 had so far been received for the zoological gardens in Bronx Park. New subscriptions to the fund include $5,000 subscribed by J. Pierpont Morgan, $2,500 by Tiffany & Co., $2,500 by F. Augustus Schermerhorn, $2,500 by Philip Schuyler, $1,000 by George Crocker, $1,000 by Jacob H. Schiff, and $500 by Eugene G. Blackford. The Society now has 540 members.

A ZOOLOGICAL Society has been established in West Australia with a view of founding a zoological garden at South Perth.

MONEY has been appropriated by the trustees of Amherst College for the purchase of a new telescope to replace the old instrument in use at present, and the bequest of $18,000 for the purchase of a site for a new observatory will be expended as soon as the various plans for a new location have been carefully considered.

THE Iron and Steel Institute of Great Britain will hold its annual meeting at Stockholm in August of next year.

DR. ANNINGSON, Dr. Donald MacAlister and Professor Kanthack will represent Cambridge University at the Madrid International Congress of Hygiene and Demography in April, 1898.

AT the 284th regular meeting of the Biological Society of Washington, on Saturday, December 18th, officers for 1898 were elected, as follows: *President*, L. O. Howard; *Vice-Presidents*, B. E. Fernow, Richard Rathbun, F. V. Coville, Chas. D. Walcott; *Recording Secretary*, Charles Louis Pollard; *Corresponding Secretary*, F. A. Lucas; *Treasurer*, F. H. Knowlton; *Councillors*, W. H. Ashmead, C. W. Stiles, E. L. Greene, F. W. True, M. B. Waite.

AT the statutory annual meeting of the Royal Society of Edinburgh, held on November 22d, the following office-bearers were elected for the ensuing session: *President*, The Right Hon. Lord Kelvin, F.R.S.; *Vice-Presidents*, The Hon. Lord McLaren, F.R.S., the Rev. Professor Flint, Professor McKendrick, M.D., F.R.S., Professor Chrystal, Sir Arthur Mitchell, K.C.B., Sir William Turner, F.R.S.; *General Secretary*, Professor P. E. Tait; *Secretaries to Ordinary Meetings*, Professor Crum Brown, F.R.S.; Mr. John Murray, LL.D.; *Treasurer*, Mr. Philip R. D. Maclagan, F.F.A.; *Curator of Library and Museum*, Mr. Alexander Buchan, M.A., LL.D.

AN International Congress of Balneology will be held in Vienna in March, 1898. Further information regarding the Congress may be obtained from the General Secretary, Dr. Brock, of Berlin.

MR. WRAGGE, the meteorologist, who established and worked the first observatory on Ben Nevis, and who is now Meteorological Observer of Queensland, has arrived on the summit of Mount Kosciuszko, the highest mountain in Australia, for the purpose of establishing an observatory there.

THE bequest of the late Sir William McKinnon to the Royal Society for the purpose of furthering natural and physical science, including geology and astronomy, and for the furtherance of original research and investigation in pathology by prizes and scholarships, which we announced last week, will, it appears, amount to more than $80,000.

The Kansas University Quarterly for October contains two important articles by Professor Williston, one on the 'Range and Distribution of the Mosasaurs, with Remarks on Synonomy,' and the other on a Labyrinthodont from the Kansas Carboniferous. This, as Professor Williston remarks, is of particular interest, for while Professor Marsh had described the footprints of Labyrinthodonts from the Upper Carboniferous the tooth noted came from the Lower Carboniferous, or from an earlier horizon than noted elsewhere.

Appleton's Popular Scientific Monthly for January will contain a translation of the important address given by Professor His, of Leipzig, in memory of his friends Ludwig and Thiersch.

BEGINNING with January, 1898, the *American Geologist* will contain an alphabetical author catalogue of articles relating to the geology of North America. Each month's issue will include titles of articles received up to the 20th of the preceding month. Sheets containing this catalogue will be mailed monthly to libraries or individuals at $1.00 per year, provided a sufficient number of orders are received to cover the expense.

THE London *Times* states that the inaugural general meeting of the Automobile Club of Great Britain took place on December 8th, at the Club premises, 4 Whitehall Court, Mr. Roger W. Wallace being in the chair. The objects for which this institution has been established are described as the encouragement and development of the motor and allied industries in England, and one of its leading characteristics is that it is to be essentially a members' club, conducted quite independently of any personal interests. It aims at affording its members support in the protection and defence of their rights where menaced and at being a social club where they may obtain information and advice on all matters appertaining to motor vehicles. At the meeting yesterday the chairman gave a brief review of the position and policy of the Club, and certain routine business was transacted in connection with its organization and the formal opening of its premises for the use of members. Afterwards there was a display of various types of motor vehicles, which conveyed members and their friends for trial runs along Whitehall Court and the Thames Embankment.

UNIVERSITY AND EDUCATIONAL NEWS.

SIR W. C. MCDONALD, whose gifts to McGill University have already been very generous, has just given an additional two hundred and fifty thousand dollars to the institutution. Fifty thousand dollars of this sum is to be used as an endowment in strengthening the law faculty, and the remaining two hundred thousand dollars is for the scientific departments.

A TRAVELLING fellowship, of the value of $500, has been established at Haverford College, through a gift of some of the alumni.

THE contest over the will of the late William Lampson, bequeathing about $500,000 to Yale University, has been dismissed by the lower courts, but it is said that the case will be carried to the Supreme Court.

THE will of the late Mrs. Julia B. H. James makes the Massachusetts Institute of Technology and the Boston Museum of Arts her residuary legatees.

ON the early morning of December 18th Pardee Hall, the building containing most of the scientific departments of Lafayette College, was destroyed by fire, with the exception of the east wing. The loss on the building is probably covered by insurance, but valuable collections have been lost. The original building was erected at a cost of over $200,000, the gift of Mr. Ario Pardee, and was completely destroyed by fire in 1879.

THE registration in the University of Michigan is reported as follows:

Literary	1,297
Law	723
Medical	431
Engineering	274
Dental	220
Pharmacy	77
Homœopathic	60
Total	3,083

THE registration in the different schools of Columbia University on November 7, 1895, 1896 and 1897, respectively, was 1806, 1796 and 2033, exclusive of students of Barnard College and auditors. The college of Columbia University is small, containing only 312 students, but the graduate and professional schools have about the same number of students as the corresponding schools of Harvard University—namely, 1,762 at Harvard and 1792 at Columbia. The entrance classes in Columbia have decreased this year—582 as against 651 in 1896, the loss being in the Medical and Law Schools.

THE Cornell University Register, of which we have received an advance copy, shows a gain in numbers, the total to date being 1,790 as against 1,763 at this time last year. The University now shows the largest registration ever reached at this point in the academic year, and with the usual growth during the year it will have be-

tween 1,800 and 1,900 students in the spring term. The number of students entering the College of Civil Engineering and the College of Agriculture shows large percentages of increase, and the attendance in the New York State Veterinary College is somewhat increased. 431 degrees were conferred in June, 1897, an increase of 50 over any preceding year.

DR. WALDEMAR LINDGREN, of the U. S. Geological Survey, will deliver a course of lectures on mining and metallurgy at Stanford University, but has not accepted a permanent appointment, as has been announced.

MISS JULIA SNOW, PH.D. (Munich), has been appointed instructor in Botany in the University of Michigan.

DR. W. H. R. RIVERS, of St. John's College, Cambridge University, has been appointed university lecturer in experimental psychology. Mr. W. L. H. Duckworth, of Jesus College, has been recognized as a lecturer in anthropology.

MR. J. W. W. STEPHENS, B.A., M.B., Caius and Gonville, has been elected John Lucas Walker Student in Pathology, Cambridge University, *vice* Mr. L. Cobbett, M.A., M.B., Trinity; and Mr. H. K. Wright, M.D., C.M., McGill University, Montreal, has been awarded an exhibition of the value of £50 from the John Lucas Walker Fund.

DISCUSSION AND CORRESPONDENCE.

THE AGONOID GENUS PERCIS OF SCOPOLI.

THE generic name *Percis* of Scopoli has been universally forgotten, but must be revived, and lest it should be overlooked in the great work of Drs. Jordan and Evermann I would call attention to it now. The genus for which the name was proposed by Scopoli is generally known as *Hippocephalus* of Swainson (1839). It was, however, well defined by Scopoli in 1777, and based on the *Cottus japonicus* of Pallas. The description will be found in Scopoli's 'Introductio ad Historiam Naturalem' (p. 454). The only species mentioned was *Percis japonicus*.

The genus *Percis* is the representative of a sub-family distinguished from the *Agoninæ* by the anterior position of the first dorsal fin and may be called *Percidinæ*. The other genera are *Agonomalus* and *Hypsagonus*.

WASHINGTON, D. C. THEO. GILL.

SCIENTIFIC LITERATURE.

RECENT MATHEMATICAL BOOKS.

Elements of Plane and Spherical Trigonometry. By EDWIN S. CRAWLEY, Assistant Professor of Mathematics in the University of Pennsylvania. Second edition, revised and enlarged. Philadelphia, E. S. Crawley. 8vo. Pp. 178.

In the writing of a text-book on Trigonometry there is now-a-days practically no opportunity for any assertion of individuality. The subject is of small extent, definitely bounded, and crystallized into final shape. There is, indeed, a possibility of trimming the treatment down to the absolutely indispensable part of plane trigonometry, which might then be gone over by a class in ten weeks or even less. But the whole tendency is the other way, and chapters on trigonometric equations, De Moivre's theorem, etc.—in short, a pretty complete discussion of the whole field—are now demanded in a text-book. The teacher must decide for himself how much of the whole material he will cover, and he will do well to bear in mind two facts, or rather two phases of the same fact, viz: (1) that teachers of applied mathematics constantly complain that their students do not bring to them a practical working knowledge of trigonometry; (2) that no student, however gifted or however taught, ever fully understands his elementary mathematics until he has gone through the Calculus.

Professor Crawley's book first appeared in 1890. The present second edition has been revised and enlarged by: (1) the adoption of definitions of the trigonometric functions applicable to angles of any magnitude; (2) the addition of a large number of exercises to illustrate the best methods of trigonometric reduction and analysis; (3) a large increase in the number and variety of the examples; (4) additional theorems on the described circles and Brocard's points; (5) a new chapter on De Moivre's theorem and the hyperbolic functions. A previous knowledge of logarithms is expected of the student, and the book is without tables. The plane trigonometry occupies 119 pages, and

the spherical trigonometry 51 pages. Answers are given at the end of the book, but not in cases where they would detract from the value of the examples.

Numerical Problems in Plane Geometry. By J. G. ESTILL. New York, Longmans, Green & Co. 8vo. Pp. x+144.

Of their own motion or in conformity with the unanimous recommendation of the conference of colleges and preparatory schools held at Columbia University in February, 1896, most of the better colleges have abolished the superannuated entrance requirement of a formal examination in arithmetic, and now prescribe in its stead the ability to solve numerical problems in plane geometry and a knowledge of the metric system and in some cases of logarithms. Mr. Estill's book, which is intended to furnish the requisite exercise in all three subjects, contains 49 pages of problems divided into books corresponding to the usual arrangement of the geometries in more general use. These are followed by 52 pages of recent entrance papers of an unusually large number of colleges, together with individual problems taken from similar papers. A five-place table of logarithms, with explanations and examples, occupies the next 38 pages; and the book concludes with the metric tables of weights and measures, including tables of English and metrical equivalents.

The book is not intended to take the place of other geometries, but to be used with them. The problems seem to be generally well selected. The metric system is used from the start, a favorite habit of the author being to give the data in metric units and to require the results in English measure, or *vice versa.* This is, of course, a necessary exercise within bounds, but, when carried to such an extreme as here, is calculated to give the beginner the idea that the metric system is an abominable contrivance for reckoning in terms of incommensurable numbers. Occasionally, too, the answer to a problem is conditioned on the degree of approximation to which the metric and English equivalents are to be taken, and this may well produce a feeling of uncertainty not quite in harmony with the notion of geometry as an exact science.

Plane and Solid Analytic Geometry. By FREDERICK H. BAILEY and FREDERICK S. WOODS, Assistant Professors of Mathematics in the Massachusetts Institute of Technology. Boston, Ginn & Co. 8vo. Pp. xii+371.

Wholly unlike trigonometry, analytic geometry, even in the highly restricted sense in which the name is employed by the present authors, admits of the widest variety of treatment. To what extent shall modern coordinate systems and modern methods generally be introduced? How shall the conic sections be defined? How shall the general equation of the second degree be exploited? Shall anything be said about projective relations and anharmonic ratios? These and many other questions may be settled in the greatest variety of ways by the author, and whatever his decision may be, he can with skill and care produce a highly satisfactory book.

Professors Bailey and Woods have chosen to exclude the more modern apparatus. They do not employ determinants or projective coordinates, or anharmonic ratios, but confine themselves to the ordinary Cartesian and polar coordinates and the common methods. This plan has its advantages. Beautiful and concise as the modern analytic geometry is, the beginner is perhaps not able to appreciate it at once. He must just become acquainted with a large number of new and fundamental ideas and practice himself long and slowly, before he is really able to grasp the perfect theory at all. If he learns great principles prematurely he is apt to have only a superficial understanding of them. At least this is the opinion held by many teachers.

The authors have covered the usual ground so far as plane geometry is concerned. After elementary chapters on coordinates, loci, the straight line, and transformation of coordinates follows one on the circle. The latter serves as an introduction to the conic sections, which are discussed in the next chapter on the basis of Arbogast's definition. This chapter contains also an innovation, the discussion of the general equation of the second degree with the xy term missing, a step which greatly unifies the following treatment of tangents, normals and polars. The discussion of the complete general equa-

tion occupies the last chapter of the plane geometry.

Pages 272 to 359 are devoted to solid geometry. The usual properties of the plane and line are discussed. The quadric surfaces are studied from the simplest forms of their equations, the treatment including the theory of the tangent, polar, diametral planes, conjugate diameters, circular sections and rectilinear generators. The reasoning throughout is clear and rigorous. Defects in the book are the rather scant treatment of problems in loci and the lack of good general (not numerical) examples. The book seems also disproportionately long, considering that Salmon's Conic Sections contains only 400 pages and that Smith's Conic Sections in 191 pages covers pretty well the same ground in plane geometry as the present work. F. N. COLE.

COLUMBIA UNIVERSITY.

A Handbook for Chemists of Beet-Sugar Houses and Seed-Culture Farms. By GUILFORD L. SPENCER, D.Sc. New York, John Wiley & Sons. 1897. Pp. 475.

The beet-sugar industry, one of the most important industries of Europe, has of recent years attracted considerable attention and gained a hold on the public interest in various sections of the United States.

The painstaking and exhaustive researches into the various phases of successful beet-culture pursued for some time by the United States Department of Agriculture, largely under the able direction of Professor H. W. Wiley, have resulted in making available a vast fund of valuable information bearing on the best conditions of soil, climate, etc., for the growing of sugar-beets.

A practical confirmation of the validity of the conclusions determined by these investigations is to be found in the results obtained by the several beet-sugar factories now in successful operation in California, Nebraska, New York and elsewhere in our States. The combined capacity of these factories is, at the present, estimated to be about four thousand tons of beets, daily.

Under these conditions it was felt to be desirable to have a reliable chemical guide for those entering upon the pursuit of this newly developing branch of American industry.

The Handbook for Beet-Sugar Chemists has been written by Dr. Spencer with the express purpose of meeting this need and demand.

The author, who has been connected with the United States Department of Agriculture for some years, and who has taken an active part in its researches and investigations in beet-culture, has certainly acquitted himself ably of the self-set task.

This volume is modeled closely on the lines of the author's earlier publication, 'Handbook for Sugar Manufacturers,' which is devoted almost exclusively to the cane-sugar industry.

Nearly all of the numerous tables of the earlier work are reproduced in this, and, of course, others are added to meet the requirements of the sujects specifically treated of in these pages.

Directions for sampling and averaging beets are carefully given. The optical and chemical methods of sugar-analysis are concisely and clearly described. Analysis of the beet, the juice, the syrup, of the marsecuites and molasses and the sugars, receive attention in separate chapters, as do also the analysis of boneblack, limestone, coke, etc. Proper stress is laid on the principles upon which beet-selection is based and the methods of seed-testing are fully explained. The author's style is clear and lucid ; the numerous references to authorities, given throughout the book, a valuable feature.

The problem of selecting the most desirable methods from the wealth of material stored in the current technical literature is a difficult one and has been well solved by Dr. Spencer. Care has evidently been given to the proofreading; the misspelling of the name Karcz—which is given as Kracz in both text and index—but serves, as an exception, to prove the rule. The text covers about three hundred pages ; it is followed by more than a hundred pages of 'Blank Forms for Practical Use in Sugar House Work,' and some thirty pages are given to a 'Summary of Yield and Losses.' Then follows the index ; in the writer's opinion it had better be placed immediately after the text, to which it refers. The book is bound in morocco;

paper and typography are very good. The insertion of advertisements, however, in a book of this kind seems, to say the least, in questionable taste.

FERDINAND G. WIECHMANN.

The History of Mankind. By PROFESSOR FRIEDRICH RATZEL. Translated by A. J. BUTLER, M. A. New York, The Macmillan Company. 1897. Vol. II., with maps and illustrations. Pp. 562. Price, $4.00.

This is the second volume of the translation of the second edition of Ratzel's 'Ethnographie,' which, for unknown reasons, the publishers have chosen to miscall 'The History of Mankind.' The first volume has already been noticed in this JOURNAL. (See SCIENCE, October 23, 1896.)

It is a handsome book, printed in clear type on excellent paper, with two maps of the distribution of the African races, ten colored illustrations of ethnographic objects and several hundred engravings in the text. These are not fancy sketches, but real helps to the student, selected from the best works of travellers or taken from authentic objects in museums of ethnography.

Professor Ratzel ranks among the chief living authorities on general ethnography, and there is no work in our tongue which surpasses this in abundance and accuracy of information. It can be recommended to readers and students without hesitation.

The present volume takes up the American Indians and the black races of Africa. The author has seen fit to interpolate between these a description of those whom he calls 'The Arctic Races of the Old World,' to wit, the Chukchis, Samoyeds, Gilyaks, Lapps, etc., usually included in the term 'Ural-Altaic Peoples.' Yet he acknowledges (p. 209) that 'we must not talk of a hyperborean race,' and intimates, what is undoubtedly the fact, that these peoples were not originally Arctic dwellers, but lived in the more genial climes to the south.

The Americans he divides, or rather meant to divide, following the artificial distinction of Waitz, into 'wild' and 'civilized' tribes; but the translator has, instead, made the distinction into 'cultured races' and 'civilized races!'—an error repeated in the table of contents and text. This unreal contrast, however, is less respected by the author in his treatment than in his plan. He recognizes the solidarity of native American culture everywhere. He also speaks positively in favor of the unity and antiquity of the race; and, with not quite so clear a note, of the independence of its culture. Nothing could more fully express a true apprehension of the American question than his words (p. 10), "Rightly understood, the New World has to supply the key to the greatest problems of anthropology and ethnology."

In details he is sufficiently full, and usually they are presented with fairness. For instance, on the mooted question of the Eskimos he decides that they are physically affined to Asian types, but in language and culture are Americans. The former is true chiefly of those in Alaska where admixture of blood may be apprehended.

His discussion of the native religions, both of America and Africa, leaves something to be desired. The time has passed when such terms as 'sun-worship,' 'moon-worship,' 'fetishism,' and the like, satisfy the student of comparative religion. These refer to externals merely and do not reveal the real religious thought. The similarities of Polynesian and American mythologies are dwelt upon (p. 147), but the translator pertinently adds in a note (p. 148) that students of Greek mythology will also 'find parallels in every part.'

It seems a deficiency to treat of totems as 'animal and plant symbols' (p. 131); they were much more than that, and often neither animal nor plant. The opinion he intimates (p. 165) that the 'Toltecs' largely created the culture of Central America is surely wide of the mark, as has been shown recently by Sapper, and his estimate of the social condition of ancient Peru (p. 201) is higher than students now would concede.

The negro races of Africa are treated with much ability. He distinguishes between the light-colored stocks, the Bushmen, Hottentots and Dwarfs of the southern and eastern parts of the continent and the Central Africans. He traces the widespread Bantu nations with precision, and gives cogent reasons for believing

their comparatively recent migration into the greater part of their present territory. The Dwarfs he considers anthropologically connected with the older inhabitants of the land and with the southern light stocks. The maps show, the one the limits of the civilizations of Africa, the other the localization of its numerous stocks. They are carefully drawn and useful.

The publication of the English version of this standard work should stimulate the study of this important branch of science. Though too large for a text-book, as a work of reference it should be in every educational library.

D. G. BRINTON.

UNIVERSITY OF PENNSYLVANIA.

Bau und Leben unserer Waldbäume (Structure and Life of our Forest Trees). By DR. M. BÜSGEN, Professor at the Forest Academy at Eisenach. Jena, Gustav Fischer. 1897. 8vo. Pp. 230.

This timely book fills a long-felt want and is, we believe, the first and only publication in any language which has ever attempted separately and in extenso and yet concisely to bring together all our knowledge of the structure and physiology of this most important group of plants; R. Hartig's and J. C. Müller's Handbooks coming next to such an attempt. This book deals, as the title indicates, with the arboreal forms of Germany; but as these are typical of all temperate zones, and the discussion is of general laws and does not refer to any particular species, it covers our own needs in this field. It is written, as the preface states, "to facilitate orientation for botanists and foresters and for all those non-professionals who desire to obtain an insight into the life and working of our forests."

From this we should not, however, anticipate that the subject has been treated in that 'popular' method of presentation which is characterized by lack of thoroughness and an attempt to please by selection rather than to instruct fully. On the contrary, the book is written in a thoroughly scientific spirit, with due regard to completeness and to the relative importance of the various parts of the subject, albeit here and there treated somewhat scantily.

The author, formerly professor at the University of Jena, has evidently brought to his task not only a thorough knowledge of the literature on the subject, at least the German and French, to which he closely and copiously refers in all particulars, but has compiled the facts with critical judgment.

Having been accustomed by his position to present the subject to a class of students who are trained to make practical use of the same in their professional pursuits, he has known how to lay most weight on the essentials from that point of view. If we add that the diction is simple and the literary style pleasing, we have given all the points that make a good and useful book. Even the usual deficiency of German books, the absence of a full index, is, in part at least, overcome by a 'register of matters not readily to be found through the table of contents.' How very deficient this register is may be illustrated by one example: Although in the chapter on causes of tree form, under the caption 'The Wind,' frost phenomena of arctic regions are discussed—and nowhere else—the index contains no reference under 'frost,' and certainly the table of contents would hardly lead one to the place. The disposition of the material appears often not very logical and hence an index is so much the more desirable.

Lack of space forbids us to go into a critical review in detail. We may only give an idea of the contents by giving titles of chapters. 'The Winter Aspect of Trees' is the title of the first, followed by 'Causes of Tree Form' as the second chapter. These two chapters could, with the aid of N. J. C. Müller's painstaking—unfortunately much overlooked—work have been profitably enlarged. The chapter on 'Buds' is followed by 75 pages devoted to the body of the tree in six chapters, discussing the 'character and functions of the formative tissues of the tree,' 'the elements of the woody tissue' and 'the bark,' the 'annual ring,' 'structure and weight of wood and heartwood formation.' The 'foliage' and 'the root' have each a large chapter devoted to them.

In the chapter on the 'Water Supply of the Tree' we note a curious misconception of an interesting experiment of Strasburger's, into which the great experimenter himself seems to

have been misled, resulting in the statement that 'the living cells of the wood do not take part in the water conduction.' The absurdity of this conclusion, philosophically apparent, can easily be demonstrated by experiment. While as a rule the unfortunate lack of knowledge of the physiology of trees is everywhere acknowledged, it appears to us that with regard to this most difficult problem the writer allows himself to become over-sanguine when he thinks that Dixon and Joly, and Askenay have solved it, however much they may have done to bring the matter under the scrutiny and explanation of physical laws and physical forces.

A chapter on the 'Derivation and Significance of the Mineral Food Elements in Trees' is followed by one on the 'Transformation and Transmission of Food Materials in the Tree,' and a chapter on 'Something about Flowering, Fruiting and Germination' ends the whole somewhat lamely, the necessity of space limitation working disadvantageously in this chapter.

The professors and students of forestry in this country, which are beginning to be called for by our necessities, will find a most convenient compendium of tree physiology in this handbook.

B. E. FERNOW.

Beiträge zur Kenntniss der Septalnectarien. Von J. SCHNIEWIND-THIES. Jena, G. Fischer. 1897. Mit 12 lithographischen Tafeln. Pp. 87.

As is well known, ovarial nectaries are confined to the Monocotyledons, occurring in the Liliifloreæ and in the Scitamineæ. The authoress has made a comprehensive and thorough investigation of these, as the result of which she distinguishes seven different types of nectaries, the simplest of which occur in those genera which stand lowest in the scale of development. The development of the complex out of simpler types can be followed through a series of forms which show strikingly how the development of the vascular bundle system has gone hand in hand with that of the nectary and how the secreting power of the cells has increased in the more complex forms.

In the simplest cases the secretion of nectar takes place all over the surface of the ovary. Next we find the nectaries confined to lines which correspond to the septa and more or less depressed in clefts and furrows. In the higher types we find the nectaries in the interior of the ovary, always occurring in the septa and discharging their secretions by means of an opening which reaches the surface. These internal nectaries are often of complicated structure and may or may not be accompanied by nectaries located on the surface.

The structure of septal nectaries was investigated in a large number of genera belonging to the Liliaceæ, Amaryllidaceæ, Iridaceæ, Musaceæ, Zingiberaceæ, Cannaceæ, Marantaceæ and Bromeliaceæ.

The behavior of nucleus and cytoplasm in the secreting cells was also investigated. During the development of the ovary the secreting cells gradually become differentiated from the ordinary parenchyma cells; their cytoplasm becomes denser and they are very poor in starch, while the parenchyma cells contain an abundance of it. The nuclei of the secreting cells increase in size and become much richer in chromatin than the nuclei of the parenchyma cells; the number of nucleoli often increases. As soon as the differentiation of the tissues of the ovary is complete the secreting cells give a strong reaction with Fehling's solution. Their nuclei in many cases partially lose their walls and assume various constricted, branched and other irregular shapes. The nucleoli diminish in number, size and staining power, except in certain cases, where the reverse takes place.

During the period of their greatest functional activity the secreting cells use up starch stored in the neighboring parenchyma cells. Their cytoplasm gradually diminishes and often disappears completely. The irregular nuclei become still more irregular and often lose their walls entirely. In most cases the chromatin and nucleoli are more or less completely dissolved, but sometimes the chromatin remains intact. The colored plates illustrating changes in cell-structure are of much value, but leave much to be desired in finer details. Some experiments made by the author seem to show that a diastatic ferment is present in the nectary and its secretions.

The comprehensive and thorough investigations of Frau Schniewind-Thies constitute an

important contribution to our knowledge of the anatomy and physiology of septal nectaries and of nectaries in general. Especial mention should be made of the twelve excellent lithographic plates which illustrate nectaries in position in the flower, cross and longitudinal sections of ovaries and nectaries and the details of cell-structure in the secreting cells.

W. J. V. OSTERHOUT.

UNIVERSITY OF CALIFORNIA.

The Living Substance as Such, and as Organism. By GWENDOLEN FOULKE ANDREWS (MRS. ETHAN ALLEN ANDREWS). Supplement to Journal of Morphology, Vol. XII., No. 2. Boston, Ginn & Company. The Athenæum Press. 1897.

This work is devoted principally to discussing the more general questions of biology in the light of the very interesting facts ascertained by the examination of *living* protoplasm under the highest powers of the microscope—a method that of late has fallen into undeserved disrepute, especially so far as metazoa are concerned. Bütchli's theory of the foam-like structure of protoplasm is adopted and a number of additional observations tending to put it on a firmer foundation are recorded. The term 'Bütchli's structure,' however, is used in a sense that would probably not be subscribed to by this investigator, as designating not the foamy structure of protoplasm in general, but merely the foam whose alveoli are from ½ to 1 micron in diameter, excluding the coarser vacuolations on the one hand and on the other the 'finer foam' discovered within the substance of the partitions between the alveoli. It is to this finer foam that the principal rôle in the activities of the living substance is ascribed. The simpler movements, such as amœboid flowing seem to have for their especial organ the 'structure of Bütchli,' but the modifications of these processes, such as those taking place in the minute filose pseudopodia of many protozoa and the more complex activities of protoplasm in general, depend upon the finer foam. By this means the way is pointed out for a reconciliation of the alveolar and fibrillar theories of the structure of protoplasm. True fibres are actually found in the cell in mitosis, and at other times, but from their activities these are considered to be made up of the finer foam and to be frequently comparable to filose pseudopodia, except that they are formed on the inside of the cell.

With this structure as a basis the more general questions are considered and an interesting point of view arrived at. The important thing everywhere is the 'continuous substance' separating the alveoli. The cell is but a differentiation of this, presided over by a metabolic organ, the nucleus. In the living metazoan cells are constantly seen to be connected by a most changeable host of filose pseudopodia along which visible exchange of material may take place. Metabolism is merely a means for furnishing the 'continuous substance' with the proper internal environment, and the organism an accidental organization of it for the purpose of acting upon the external environment and thus furnishing the proper internal surroundings. Heredity is a provision of the substance for the future essentially similar to, though more complex than, the provision for a future internal environment made in injecting food. Thus the necessity for complex theories of transmission vanishes and the study of the structure and activities of the 'continuous substance' becomes of paramount importance.

Unfortunately, the poor style makes the reading much more difficult than the subject warrants. Facts and theories are mixed, unusual constructions are frequent, and in the purely descriptive parts even ambiguous expressions are encountered. That this lack of clearness is apparently due to careless composition seems to be shown by occasional sentences like the following from page 115: "If by coalescence, the substance as such showed respect to that position in the mass in which it newly found itself, exactly as in each individual it had through all its ceaseless flux respected its relative position; for it must not be forgotten that in these protoplasts the substance as such is ever changing its position in the mass or organism."

System der Bakterien, Handbuch der Morphologie, Entwickelungsgeschichte und Systematik der Bakterien, Band I., Allgemeiner Theil. Von DR. WM. MIGULA, a. o. Professor an der

technischen Hochschule zu Karlsruhe. Jena, Verlag von Gustav Fischer. 1897. Octavo of 368 pages, illustrated by 40 photographic reproductions and one diagram.

The volume before us represents the first section of a work on bacteriology. It opens with an instructive critical review of those investigations that have played so important a part in the development of our knowledge of the subject, especially as concerns morphology, classification, etc., dwelling at some length upon the historic works of Leeuwenhoek, O. F. Müller, Ehrenberg, Dujardin, Perty, Cohn, Nägeli, and DeBary.

The second section contains a discussion of the morphology, structure, modes of development and reproduction, chemical constitution, and metabolic activities of bacteria; while the third section is devoted to brief considerations of certain specific biological functions of bacteria—such, for instance, as their relation to culture media, their chromogenic functions, their specific properties of fermentation, anærobiosis, phosphorescence, and their relation to light and to temperature.

It is an excellent presentation of these phases of the subject, especially the section relating to the finer structural details of bacteria. Indeed, this portion of the work is particularly elaborate, the subject being treated with much more detail than is usual. In this respect it may serve to satisfy the demands so frequently made by the botanists for more attention on the part of bacteriologists to the morphological side of bacteriology. We must confess ourselves, however, to be of the number who not only find greater entertainment and instruction from the study of the biological functions of bacteria, but who also believe this to be much the more important line along which to develop the work.

This volume contains no reference to the relation of bacteria to the more highly-organized beings, and comparatively little upon their important rôle in the great processes of nature—points that will doubtless receive due attention in the forthcoming second volume of the work.

The literary references are full and are conveniently grouped at the end of each chapter in alphabetical order.

A. C. ABBOTT.

SOCIETIES AND ACADEMIES.

THE 97TH REGULAR MEETING OF THE CHEMICAL SOCIETY OF WASHINGTON, NOVEMBER 11, 1897.

THE first paper of the evening, read by Dr. H. C. Bolton, was entitled 'Hysterical Chemistry,' a term which he applied to the preposterous theories and claims of a certain small group of writers on chemistry who call themselves Monists. They advocate unity of matter and reject identity, replacing the latter by analogies. He gave examples of their method of reasoning, one instance being the following:

"An atom is a hypothesis,
A hypothesis has no weight, therefore
Atomic weight is a nonentity."

The speaker showed that these writers did little or no experimental work, yet claimed to be revolutionizing chemistry by their publications; also that they deserve no serious consideration.

Mr. Wirt Tassin's paper, entitled 'The Preparation of Crystals,' consisted of a review of the several methods of preparing crystals for the determination of their geometrical and physical constants, the methods being grouped under the following heads:

A. Solution, treating of the preparation of crystals of a substance from its solution in a liquid by evaporating and cooling the solution; by the reaction of soluble compounds, or by chemical changes in general. The general rules to be observed being:

1. The crystallization must proceed as slowly as possible.

2. The solution must be of the least viscosity possible.

3. The crystallizing substance must be present in the solution in the greatest quantity.

4. The crystals desired for measurement must be removed from the solution, preferably when it is at its minimum temperature, and must be quickly and completely dried in order to prevent corrosion or etch figures forming.

B. Sublimation, in which case the crystals may be obtained direct, or a non-volatile compound may be obtained as a result of chemical action between two or more volatile substances, or from a volatile substance and a gas.

C. Fusion, where the crystals are secured by slowly cooling a homogeneous magma, or by a

solution of the substance in a molten magma, and the crystals are formed either with or without pressure.

The last paper of the evening was read by Dr. E. A. de Schweinitz, and was entitled 'A Convenient Dropping Bottle.' This bottle was devised especially to be used by ophthalmologists for the purpose of keeping collyria sterile and free from dust, and at the same time one which was very easy to handle, and from which the solution could be dropped into the eye with almost any desired rapidity. It is a small pear-shaped flask with a long tubular neck at a right angle to the bottle. The end of the neck is drawn out to a moderately fine point and provided with three bends, so that the end of the tube dips downward. The object of these bends is to prevent the dust from entering the bottle. At the same time when they are filled with liquid the rest of the solution is sealed. On the side of the flask opposite the neck is a short open arm, to which a small rubber dropping bulb can be attached to regulate the rapidity with which the liquid is allowed to flow out at the bottom. A little cotton should be placed in this arm to keep out the dust. The dropper is adapted for general microchemical and volumetric work.

Professor Chas. E. Munroe made an exhibit of paraformaldehyde and the lamps used in generating formaldehyde from it. This substance is sold in the form of tablets. Contrary to the general belief, it is comparatively readily soluble in hot water. It makes a convenient laboratory source of formaldehyde. The gas is very readily given off from the tablets at comparatively low temperatures.

Mr. V. K. Chesnut exhibited specimens of *Amanita muscaria*, the fungus which caused the recent death, in Washington, of Count de Vecchj, and the serious poisoning of Dr. Daniel J. Kelly. Colored plates were shown, which showed how the fungus was mistaken for that of the closely related but edible species, *Amanita cæsarea*. Brief remarks were also made about the poisonous constituents characteristic of the two most poisonous Amanitas and their characteristic action on the human system.

V. K. Chesnut,
Secretary.

BIOLOGICAL SOCIETY OF WASHINGTON—283RD MEETING, SATURDAY, DECEMBER 4.

Mr. Lyman J. Briggs presented a paper on 'The Causes of Water Movement in Soils,' showing that the capillary movement of water in soils depends upon the form of the surface of the water contained in the capillary space between two soil grains in contact. The direction and relative magnitude of the pressure of films of several geometrical forms was considered, and the resultant movement of water in soils under such conditions was pointed out.

Mr. Sylvester D. Judd read a paper entitled 'Protective Adaptations of Insects from an Ornithological Point of View.' Such protectively colored insects as grasshoppers, he stated, are eaten in large quantities by practically all land birds that are to any extent insectivorous. The *Geometrid* caterpillars, which so closely simulate twigs, were found in the stomachs of a score of our commonest birds. Vile-smelling or ill-flavored insects, such as many bugs, *Carabid* beetles and *Chrysomellid* beetles, are greedily devoured by the majority of land birds. Numbers of species of insects exhibiting warning coloration and protective mimicry are selected for food by birds. The Kingbird catches the *Erastalis* fly that imitates a honey bee. It also takes honey bees, but in doing so selects only the drones. The author concluded by saying that the interaction between insects and birds does not afford the best example of the greatest efficiency of the protective adaptation of insects.

Dr. Theo. Gill spoke on 'The Distinctive Characters of the Molinæ and Ranzaniinæ,' saying that the family represented by the gigantic sunfish of the Northern Atlantic (*Mola mola*) is also represented by another smaller species, but which is generally regarded as nearly related—the *Ranzania truncata*. These two resemble each other so much superficially that many (including Dr. Günther) have combined them in the same genus. Anatomically, however, they are so widely different that they should be distinguished as subfamily types at least, if not as families. The subfamilies were distinguished as long ago as 1838, by Prince Bonaparte, but the characters partly transposed. The Molinæ have the skeleton mostly cartilaginous and the dorsal and anal fin rays invested in the com-

mon skin, while the Ranzaniinæ (*Orthragoriscini Bon*) have the skeleton 'Sub-osseous' and the rays distinct. The most important of the other characters were detailed.

Dr. C. W. Stiles presented a paper on 'The Honorary Ph. D.'

F. A. LUCAS, *Secretary.*

U. S. NATIONAL MUSEUM,
WASHINGTON, D. C.

THE 268TH REGULAR MEETING OF THE ANTHROPOLOGICAL SOCIETY, TUESDAY, DECEMBER 7, 1897.

THE evening was devoted to a symposium upon Anthropology at the Field Columbian Museum, by Professor Wm. H. Holmes; at the American Museum of Natural History, by Professor Otis T. Mason, and at the Brussels International Exposition, by Dr. Thomas Wilson.

Professor Holmes described briefly the origin and growth of the Field Columbian Museum, of Chicago, and presented a photographic view and ground plan of the building—the Art Building of the World's Fair. The plan was colored to show the arrangements of the departments of the Museum, and especial attention was given to Anthropology. The arrangement of the collections was pointed out and the more interesting and valuable exhibits described.

Professor Otis T. Mason gave a description of the arrangement of the exhibits at the American Museum of Natural History in New York, and dwelt upon the Polynesian collection and the method of its being brought together, stating that each object, as it was obtained, was labeled with its origin, with its surrounding history and every fact that it was possible to find. He noted the difference between the various methods employed by the heads of the several museums, and believed that a diversity of methods was valuable, as it gave an opportunity for the display of each man's idea, and that stress was thus laid on the subject from many points of view.

Dr. Thomas Wilson gave a review of the Brussels International Exposition, of which Professor J. H. Gore and himself were the United States Commissioners. The Exposition was primarily a commercial one and was intended to show, first, what Belgium had to sell, and secondly, what she had to buy. The scientific department was under the direction of a number of scientific gentlemen, of whom Professor Houze was Chairman or Director-in-Chief. The scientific department was located in the great hemi-cycle, which embraced one of the great or main entrances.

Since the United States was only allowed $5,000 by Congress for its exhibit, no part of which could be expended for salaries of the Commissioners or for defraying the freight expenses of private exhibitors from America, the exhibit from this country was necessarily smaller than usual.

The anthropologic exhibit was not large, but was very good. The Belgian division was unusually fine, the prehistoric finds of the caves and grottos being very full and complete.

J. H. MCCORMICK,
Secretary.

TORREY BOTANICAL CLUB, OCTOBER 27, 1897.

THE first paper, by Mr. P. A. Rydberg, entitled 'Botanical Exploration in Montana During the Summer of 1897,' discussed the alpine flora of Montana, adding herbarium specimens and drawings. Mr. Rydberg described a collecting trip made by him and Mr. Ernest A. Bessey to Old Hollowtop, a mountain of 10,000 feet altitude in the Pony or South Boulder Mountains. Their characteristic plants, like those of other alpine regions, are remarkable for their small size and their brightly colored flowers. Most of them are but 2–3 inches high; few exceed 5 inches. The mountain side of Old Hollowtop presents a mixture of golden-yellow, indigo-blue, the richest magenta, the most delicate pink, violet and snowy white, with a carpet of the brightest green for a background. The forage plants of these alpine peaks are chiefly small cespitose clovers, and include but few grasses. Among the trees and shrubs of the alpine peaks, the most remarkable were the five small alpine willows collected, forming a light green mat covering the mountain-side above timber line. The smaller willows of the White Mountains and of the Alps and of Siberia are giants compared with these dwarfs of the Rockies. Four of these

Montana willows, with *Salix rotundifolia* from the island of Unalaska, are the smallest shrubs of *Salicaceæ* in the world. Two of these pygmies are new to science; one of which, growing often only half an inch high, is believed to be the smallest species of willow ever known.

Dr. Britton remarked that Mr. Rydberg's Montana trip of last summer was the first expedition sent out officially by the New York Botanic Garden; to which his collection of alpine plants will return.

Professor Burgess referred to a supposed age of thirty-four years for a dwarf willow of about six inches stem from Alaska, and Dr. Rydberg mentioned twelve years as perhaps the age reached by the dwarfs of his present paper, their stems dying along the rooting base too rapidly to permit great age.

Dr. Rusby spoke of Arctic willows as part of the food of beavers in northern Russia, and of reindeer.

The second paper was by Dr. John K. Small, 'On the Genus Eriogonum North of Mexico,' a genus founded by Michaux upon a single species in 1803, and increased to ninety-five in its fourth monograph, that by Dr. Sereno Watson, in 1870.

In discussing this paper, Dr. Allen contributed an entertaining description of his difficulties in bringing growing specimens of *Eriogonum Alleni* from near White Sulphur Springs to the Botanic Garden here.

Dr. Britton reported that the specimens then secured have done well in cultivation at Bronx Park, and have matured seeds.

Dr. Allen spoke of finding two or three species of *Eriogonum* in the Grand Cañon of the Colorado last summer, and described his descent of the cañon by mule trail, and also his journey to California in search of Characeæ.

Dr. Britton reported two cases of naturalization of escapes from greenhouses; the first that of a creeping form of *Ovalis corniculata*, now becoming a noxious weed at Whitestone, L. I.

The second case is that of a fern, apparently an Asplenium from a temperate habitat.

Other cases of fern naturalization which have been previously reported include that of an Adiantum in Rhode Island, by Mr. Davenport, and a Pteris in a rock-cut near the New York Central Railroad tunnel in our own city, noted by Mr. W. A. Clute.

EDWARD S. BURGESS,
Secretary.

SCIENTIFIC JOURNALS.

American Chemical Journal, December. 'Decomposition of Heptane and Octane at High Temperatures,' by R. A. WORSTALL and A. W. BURWELL: A study of the decomposition of these substances when heated in the Pintsch gas plant. The chief products of the decomposition are the olefines, methane, acetylene and the aromatic hydrocarbons. All hydrocarbons, under the same conditions of temperature, seem to yield the same products. 'Anethol and Its Isomers,' by W. R. ORNDORFF, G. L. TERRASSE and D. A. MORTON: Preparation and study of properties and molecular weight of nine isomeric substances. 'Action of Sulphur on Silicides, Production of Silicon,' by G. DE CHALMOT: Conditions under which the silicon is replaced by sulphur. 'Acetylene Diiodide,' by G. DE CHALMOT. 'The Action of Sodium upon Methylpropylketone and Acetophenone,' by PAUL C. FREER and A. LACHMAN. 'Solubility of Lead in Ammonia,' by H. ENDEMANN. 'The Decomposition of Sulphonic Ethers by Water, Acids and Salts,' by J. H. KASTLE, PAUL MURRILL and J. C. FRAZER: A study of the rate of decomposition. 'A Study of Zinc Hydroxide in Precipitation,' by V. J. HALL: Effect of chlorides and sulphates on the precipitation.

J. ELLIOTT GILPIN.

NEW BOOKS.

Repetitorium der Chemie. C. ARNOLD. Eighth edition. Revised and enlarged. Hamburg and Leipzig, Leopold Voss. 1898. Pp. xii+616.

Les végétaux et les milieux cosmiques. J. COSTANTIN. Paris, Alcan. 1898. Pp. 292. 6 fr.

Suggestions for Laboratory and Field Work in High School Geology. RALPH S. TARR. New York and London, The Macmillan Co. Pp. 100.

Memory and its Cultivation. F. W. EDRIDGE-GREEN. New York, D. Appleton & Co. 1897. Pp. 311.

SCIENCE

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FRIDAY, DECEMBER 31, 1897.

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TIME WASTED.

To what extent are men of science responsible for the credulity which everywhere prevails in reference to all matters relating to scientific discovery or accomplishment? This question is not to be lightly set aside, for the existing condition may well create alarm among all who seriously consider the welfare of science, of scientific men and of the people generally. Several causes have conspired to bring about this condition, two or three of which may be mentioned. To begin with, during the century which is now approaching its end scientific discoveries and their applications have been so numerous and so far reaching as to practically revolutionize conditions of material existence, and they have often been so wonderful in character that it ought not to excite surprise to find intelligent people ready to accept without question announcements of inventions and discoveries of the most improbable and absurd character. Along this line the evil influence of a sensational press is enormous. It was bad enough ten years ago, but it has been greatly magnified by the recent and, on the whole, unfortunate cheapening of processes of illustration to the seductions of which nearly every news-

paper in the land has yielded. To this has been added the newspaper 'syndicate,' by which men who know really nothing of science are employed to furnish sensational articles on scientific discovery, illustrated by sensational pictures, all of which is the more injurious because often founded upon a slender, microscopic tissue of fact. Unfortunately, some men who may be said to inhabit the fringe of genuine scientific activity lend themselves to this sort of thing and are made much of accordingly. Whole pages of this modern journalism are filled with accounts of discoveries that *are going to be made*, for writers of this class are shrewd in taking advantage of the fact that human interest and human memory are now practically restricted to about twenty-four hours in time. The publication of a broadside describing an alleged improvement of the telescope or microscope, in which there is absolutely nothing new that is true or true that is new, adorned with a series of cuts largely imaginary and many of which have no relation to the subject-matter, has served the purpose intended when its author has received his pay from the 'syndicate' and when the syndicate has scored a triumph in what in these days is called 'enterprise.' Even the most conservative among men of science are made to appear as willing purveyors of sensationalism by what ought to be looked upon as an unwarranted and illegitimate use of the results of carefully conducted investigations, often before such results have received final consideration and approval at their own hands.

If *all* impressions made by this false popularization of science were to disappear in twenty-four hours the evil would be greatly lessened, but unfortunately there are many very intelligent and thoughtful people, who ought to constitute the best support of scientific work, upon whom they are more lasting. To such the line separating the genuine accomplishments of honest scholarship from the output of sensationalism, which ought to be clear and sharp, is becoming very nebulous, and there is imminent danger of a revolt against the whole thing. The extent to which credulity has been carried was beautifully illustrated not long ago when a widely known scientific man amused himself and many friends by caricaturing, in the columns of one of our standard scientific journals, some of the phases of modern psycho-physics. So perfectly did the burlesque reflect the form and substance of some recent contributions to that science that it was immediately accepted as serious by the large majority of readers.

This suggestion leads us by easy descent, or ascent, to that large and growing region of pseudo-science, the cultivators of which are, for the most part, themselves honest. For the most part, I say, for it is difficult to believe that all of the persistent advocates of unadulterated nonsense are seriously in earnest. Honest or dishonest, they usually come upon us in much the same way and nearly always find converts in sufficient numbers to enable them to press their fallacious theories upon the public attention. Their appearance is generally sudden and unexpected, and although they have never been heard of in scientific circles before; although they have never done even a small bit of work which might entitle

them to a hearing, they generally begin with some, to them, trifling performance, such as upsetting the law of gravitation or disproving the rotundity of the earth. Such work ought to be harmless, but unfortunately it is not always so. A monthly journal published at the seat of one of our largest universities, not bearing the imprint of the university, however, devotes a large proportion of its space to the exploitation of the belief that the surface of the earth is concave and not convex, presenting in evidence experimental details and results which, if true, would be startling. Such publications as this demand and receive no further attention than the occasional filing away of a copy as a curiosity. Nevertheless, it calls itself a *Scientific Monthly* and 'the greatest scientific paper in America.'

Occasionally books, more dignified in character and appearance but equally unsound in doctrine, are issued, with the imprint of publishers of established reputation, and which seem, therefore, to require more serious consideration. Of this class, is a recent volume bearing the not inappropriate title 'Some Unrecognized Laws of Nature,' the authors being Ignatius Linger and Lewis H. Berens. It is a large, handsomely gotten-up octavo of over five hundred pages and its substitute is 'An Inquiry into the Causes of Physical Phenomena with Special Reference to Gravitation.' The largeness of the subject makes the reader a bit suspicious to start with, and this feeling is considerably enhanced by the first sentence in the preface, which is as follows: "At last, after years of patient plodding in dim regions, where the footprints are few and the pitfalls many, the time has arrived when we are enabled to place before the world of science the first fruits of our exploration." A book with such a beginning means either a great deal or nothing at all, and in the present instance a brief examination of its contents suffices to show that the only message which it brings is the too common one of well-meaning men attempting to explain what they do not themselves understand and to overturn well-established principles of a science of which they appear to be quite ignorant, by the use of arguments and data the soundness of which they are utterly incapable of judging. It is really a rather ostentatious attempt to explain the fundamentals of physical science by men who seem to lack all training in methods of physical research; who show gross ignorance of the latest results of physical investigation, and who are, therefore, totally unfit for the task which they have undertaken. A few citations and examples of their methods and conclusions will furnish sufficient defense for this statement.

They declare that the four great fundamental and universal laws of matter are '*persistence, resistance, reciprocity and equalization*, each one of which,' they say, 'can be seen at work in every single phenomenon within our reach.' Their attack upon the Newtonian law of gravitation consists of the assertion that attraction is not proportional to mass, and this side by side with the equally emphasized assertion that the term 'mass' conveys no distinct idea and that we have really no notion of what it means. This, of course, is mere play, and would be unworthy of comment if it were

not followed by the declaration that the *weight* of a body can be and is changed without changing its mass, some curious experimental evidence being furnished to prove this. The conservation and dissipation of energy are denied and the splendid researches of Kelvin and Joule are overhauled and denounced by critics who declare that "Pressure is 'work' and so is motion." It is declared that Joule could not have obtained the same result for the mechanical equivalent of heat had he used mercury instead of water, and still less had he used friction on copper, iron, glass or wood, even though the 'work' expended were the same. Here the authors seem to be troubled by some sort of a notion of specific heat, and throughout the whole discussion the reasonably well-informed reader cannot fail to be astonished at the unparalleled density of honest ignorance. Their own idea of heat is that it is 'merely a state or quality of bodies, which can be augmented or diminished, and which is due to the states of coercion, *i. e.*, when bodies are prevented from satisfying their natural tendencies.' Their right to speak authoritatively on this subject is further exemplified in the remark that in the case of a falling body "the amount of heat generated will vary as the bodies striking against each other are harder. A quantity of water or mercury falling from a certain height would not generate as much heat as would a like quantity of, say, steel falling from an equal height." Some notions about electricity are reflected in the statement that thin wires offer less resistance than thick wires of the same material, and the further statement, not altogether consistent with this, that the resistance of six pounds of copper would be the same, whether only a yard in length or a mile; also in the statement that the "air between two poles of an electro-magnet can be excited sufficiently to be felt as a viscous fluid when a piece of metal is passed to and fro between the poles."

The extension of some of these unrecognized laws into the domain of astronomy affords the authors ample opportunity for the display of their peculiar logic. In the case of the earth the whole thing is very simple. Its axial motion is due to relative states of excitation of its two hemispheres divided meridianally; the motion of the vanes of a radiometer and of plants turning to the sun is sufficient evidence of this. Its change of seasons is due to a reciprocating motion originating in the relative states of excitation of the two hemispheres, divided equatorially, and its varying distance from the sun is another reciprocating motion due to variations in the aggregate state of excitation of the whole mass. The revolution of the earth about the sun is a simple phenomenon, due to the rolling of one sphere upon the circumference of another. the necessary assumption that the real diameter of the whole earth must be over 500,000 miles being no obstacle to the acceptance of so beautiful a hypothesis.

It is, perhaps, in their review of the Newtonian law of gravitation that the authors reach a maximum in their phenomenal incapacity for an intelligent discussion of the subject. They assume to disprove that law by asserting that according to it the attraction at the equator ought to be greater than

at the poles ; they try to support this assertion by reference to what they call 'another phenomenon, namely, that bodies taken down mines weigh less than when on the surface,' which is not true, as they could have known by even a brief study of gravity before undertaking to upset its accepted principles. They positively declare that two pendulums of different material made to agree in period of vibration at one point on the surface of the earth would *not* agree if carried to others, and, what is more extraordinary, they even suggest this as an *experimentum crucis* by which their theory may be tested. They are blissfully ignorant of the fact that this experiment has been tried many times in many parts of the world and that it has always gone against them, as in the nature of things it must.

It may now well be asked, is time so plenty, is other occupation so scarce and are the columns of SCIENCE so little in demand as to justify so much attention as this book has already received? Perhaps time and space are wasted, but some justification may be found in a few facts, one of which has already been alluded to—the book bears the stamp of a publishing house of the highest character and it has received lengthy and, on the whole, complimentary notice in recognized scientific journals. There is about it something of an air of scholarship calculated to impress and in some degree impose upon those who may be unable to detect its fallacies. There is considerable internal evidence to show that its authors are much more at home with metaphysics than with physics, although this may not be admitted by our brethren of that ilk. Finally, it is perhaps well to make an opportunity for emphasizing the fact that no man has a right to undertake such a discussion as this book pretends to be until he has qualified himself by an exhaustive study of the principles which he proposes to attack. No man has a right to ask the ear of men of science or of an intelligent public on matters relating to science until he has demonstrated his own ability to understand and conduct a scientific investigation, by the presentation of actual, approved work. At first blush it would seem that these men are entitled to pity and sympathy rather than harsh criticism. They richly deserve both, and especially the latter, when their pages abound in the statement that men of science are so restrained by tradition and authority that they do not expect them to receive anything new with favor. This is an old, worn-out plea and utterly inapplicable at the present time. Students of science were never so willing as now to give attention to new theories, however revolutionary they may be, and they do not always insist that they should be immediately supported by facts, provided they emanate from one whose recognized accomplishments are such as to give reasonable assurance that he knows what he is talking about. If the authors of 'Some Unrecognized Laws of Nature' will now spend as much time as they have already spent in making the book in a serious attempt to study and understand some of the recognized elementary principles of physical science, the twentieth century may listen to them, if by that time they have anything to say.

M.

GARDINER GREENE HUBBARD.

In 1883 Gardiner Greene Hubbard and Alexander Graham Bell founded this Journal. It was first published at Cambridge by Moses King, and its first editor was S. H. Scudder. The magazine was designed to be a means of communication between scientific men of America as a bearer of scientific news, an agency for the announcement of scientific discoveries and a forum for scientific discussion. It was not intended as a business enterprise, but it was hoped to establish it on a sure foundation as a gift to American scientific men. The death of Mr. Hubbard was announced in the last week's issue. As one of the original board of directors for the Journal it may be appropriate for us to recount some of his achievements in the interests of scientific affairs.

Mr. Hubbard was born in Boston on the 25th of August, 1822. He came of a scholarly ancestry, his father, Samuel, being an alumnus of Yale, and a Doctor of Laws from Yale, Dartmouth and Harvard, an accomplished lawyer, and a member of the Supreme Court of Massachusetts. The family is English, its first representative in America being William Hubbard, a graduate of Harvard in 1642 and known as an early historian of New England. Mr. Hubbard himself was graduated at Dartmouth in the class of 1841, studied law at Cambridge, and was admitted to the bar in 1843, when he entered the office of Benjamin R. Curtis and remained with the firm until Mr. Curtis was elevated to the Supreme Bench of the United States. Mr. Hubbard continued to practice his profession in Boston for more than twenty years, and subsequently in Washington for five years. The degree of Doctor of Laws was conferred on him by Dartmouth and by Columbian University. His career as a lawyer was eminently distinguished, although it terminated twenty years ago, at which time he was drawn into more active public life.

It is not Mr. Hubbard's legal experience of which we shall speak, but of the rôle which he played in certain public affairs and for which he will long be remembered. In 1860 he was led by the result of a severe illness in one of his children to investigate the possibility of teaching the deaf to speak. At this time there were two systems of instruction for deaf children prevailing in Europe—gesture language and oral speech.

In 1803 Francis Greene, a merchant of Boston who had a deaf child, thus became interested in the education of the deaf and made some study of the oral system. A memorial tablet has just been erected to Greene in Boston. In 1844 Horace Mann went to Europe and made a special study of the subject as it was practiced in Germany, and on his return attempted to introduce the system in America. About the same time the philanthropist Howe, who was the teacher of Laura Bridgeman, became interested in the same subject. An account of the case was published by the Smithsonian Institution. During this epoch the wife of Governor Lippett, of Rhode Island, whose child was deaf, attempted to teach the oral method, and about the same time Mr. Hubbard, whose little daughter had been rendered deaf by severe illness, became interested in oral speech, and by him Miss Rogers was induced to open a school of this character at Chelmsford, near Boston. Mr. Hubbard advertised for pupils for her school and supported it with his own means. The pupils here assembled made rapid progress, when Mr. Hubbard applied to the Legislature for a charter for the school. In the first instance it was refused; the chairman of the committee, himself having a deaf child, was the champion of sign language. Mr. Hubbard was not discouraged; he still pressed the subject on the public and enlisted those who

were especially interested in it by calling attention to the pupils of Miss Rogers' school, one of whom was his own daughter. He again applied to the Legislature for a charter and took the pupils of the Chelmsford school to the State Capitol and gave the committee a demonstration of the utility of the method. At about the same time he also induced Mr. Dudley to permit his child to visit Miss Rogers' school, and she became domiciled for a time at Miss Rogers' residence. In a few weeks Mr. Dudley visited his child, and when he appeared the little girl ran to her father and called him 'Papa.' He found that she was able to converse with him, being able to speak a few words and to understand a few when spoken by Mr. Dudley by interpreting the movements of his lips ; thus Mr. Dudley became a champion of oral speech, and when the subject was again presented to the Legislature he made an eloquent appeal for a charter for the school. At this juncture a gentleman named Clarke offered a sum of money for the endowment of such a school to be located at Northampton ; the benefaction was accepted by the Legislature and the charter was granted. Miss Rogers' school was transferred to Northampton, Mr. Hubbard himself becoming the president of the board of trustees, on which board he continued until his death. Thus was the teaching of speech to deaf children permanently and officially introduced into the United States.

The deaf constitute quite a large class of persons in modern society who have been rescued from a cheerless state by the efforts of philanthropic men. This class of the population had previously been condemned to a state of inactivity and dependence. In future years it will be difficult to appreciate the dreary life of the deaf as it appeared in youth to those who are now passing away with old age. Deprived of the means of intellectual culture, they seemed to be stricken with a paralysis of reason and to wander as useless burdens on society. Instruction in speech has transformed them into helpful independence, so that the deaf may now bear an integral and honorable share in the society of their fellow-men, taking a part in the activities of modern life where the sweet music of speech makes glad the soul. Mr. Hubbard did not invent oral speech, but he became the leader of the men who developed the agencies by which oral speech has become the means of communication among a class of persons who were formerly mutes and who therefore took no part in the arts, industries, institutions and intellectual activities of mankind, while now they may be active, useful and happy members of society.

The student of men as they are engaged in human development may derive a lesson of great interest concerning the interdependence of demotic activities. Arts, industries, institutions, languages and opinions are developed in such a manner that one of these realms cannot be developed without the others. So, for example, a man without institutions is more dangerous than a wolf. In the same manner the investigator as a scientific man engaged in the pursuit of knowledge must depend on the inventor engaged in the application of knowledge, who in turn is dependent on the man of affairs for the utilization of his inventions. To designate this particular class of persons the English language gives us no term. Etymologically the word 'undertaker' is appropriate, but it has been used to designate a director of funerals. The French language has the term *entrepreneur*. Mr. Hubbard was the *entrepreneur* of scientific inventions and discoveries—the man of affairs who pushed them into the service of mankind. He was the *entrepreneur* of oral speech for the deaf, for he introduced it into all of the institutions of America designed to ameliorate the

condition of this class. Men without language are imbecile, as men without institutions are anarchists; but men with language are useful and happy members of the community, as men with institutions are self-respecting citizens.

As a lawyer, business man and benefactor Mr. Hubbard had acquired national reputation, when, in 1876, President Grant appointed him chairman of a special commission to investigate the question of railway mail transportation. The labors of this commission have greatly promoted the intercommunication of the people throughout the Union, for the plans of the commission were adopted by a succession of Postmasters-General and formulated into statutes by members of Congress. The results of his work did not end in national statutes and administrative devices, for he pursued it among telegraph companies.

When Mr. Hubbard was engaged in providing speech for his daughter and then expanding his energies into providing for all the deaf of the nation he naturally became interested in the science of acoustics, and this led him into association with a young student of the science who had already become an inventor. Alexander Graham Bell had so investigated the principles of acoustics that he could invent a telephone. In this instrument Mr. Hubbard evinced a deep interest. It was an instrument to make the inaudible audible, as the microscope was designed to make the invisible visible. At first it was supposed that it might be useful in communicating between different rooms in the same building or between adjoining buildings; but Mr. Hubbard saw in it an instrument of communication for all the governmental departments of a city, all of the business institutions of the city, and all the people of a city. More than this, he conceived that it might be the means of communication from town to town and city to city throughout the country, finally to become a means of international communication. For this purpose Mr. Hubbard devised the business machinery for the introduction of the telephone to the world. He organized a company for this purpose and managed the company by business devices with a great central company and a multitude of local companies by which the telephone business was introduced into all portions of the civilized world. Now a man can be put in communication with his baker through the telephone; in the next minute he may be put in connection with a railroad office or a steamship company; at the next minute with the Governor of his State; at the next minute with some other man elsewhere in the world. To accomplish all this has taken many years of intelligent active labor. Before this we could communicate with the world by lightning light; now we can communicate with the world by lightning sound. The man who devised all this business machinery, set it into operation, and made it all a business success, was Mr. Hubbard.

Mr. Hubbard was not the discoverer of the laws of acoustics which are represented in the telephone; he was not the inventor of the telephone, but he was the *entrepreneur* who distributed the telephone among all men of the civilized world and made it a practical agency for social intercommunication. Having accomplished all these things he retired from business and made his home at Twin Oaks, in Washington City.

At the seat of the federal government there are many bureaus that have to deal with the science of geography. First, there is the time-honored bureau known as the Coast Survey, which is charting the coasts of the sea as an aid to the mariner; then there is the Geological Survey, which is making maps of the United States in the interest of mining and manufacturing;

then there is the Weather Bureau, which is making a daily map of the heavens to exhibit the temperature and storms of the land in the interest of commerce and agriculture; then there is a Hydrographic Bureau preparing charts of all the seas in the interests of foreign commerce. In addition to these great geographical bureaus there are many others that are necessarily interested in geography. Thus, the General Post Office must prepare maps of postal routes. Now the little army of men who are engaged in geographical work in Washington organized themselves into a body known as the National Geographic Society. When they were duly organized they cast about for some one who could manage their affairs as its president and who would interest himself in the diffusion broadcast among the people of this geographical knowledge, which all these bureaus were acquiring. The man selected for this purpose was Gardiner Greene Hubbard, who was elected its first president.

The function of the National Geographic Society is the discussion of the principles of geography and the diffusion of geographical knowledge among the people. To carry out this purpose Mr. Hubbard organized a journal called the *National Geographic Magazine*, which has already acquired a good circulation and become an influential publication. Then he organized a system of bulletins designed to discuss the elements of physiography as a compendious library for teachers in the public schools, and finally he organized in the city of Washington a system of public lectures on geography, enlisting not only the members of the Society, but many other able public men in this enterprise. In all of these agencies the working geographers of Washington most heartily cooperated, and the National Geographic Society has within very few years attained an influence and efficiency which is unequalled in America and perhaps in the world. Thus Mr. Hubbard was the *entrepreneur* of geographical knowledge.

Investigation and discovery lead to useful, honorable and glorious careers, but knowledge must result in invention if it becomes useful, and inventions themselves must be applied to public affairs if they are to be a boon to mankind.

Mr. Hubbard died at three o'clock on the 11th of this month, loved by his kindred, beloved by his friends and honored by the world.

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*ON THE ORIGIN AND AGE OF THE RELIC-BEARING SAND AT TRENTON, N. J.**

THE locality where human antiquities have recently been found near Trenton, New Jersey, is situated about two miles south of the heart of the city. The points where the finds are being made are on a somewhat extensive plain, the principal formation of which is composed of the sand and gravel deposited by the glacial drainage which came down the Delaware during the last glacial epoch. On the east side of the Delaware the plain extends about two miles east of the locality where the finds are made. It also has a considerable development on the west side of the river, and extends many miles up and down the Delaware north and south of the locality in question. From Trenton it also stretches northeast a number of miles along the Assanpink creek. In the vicinity of Trenton this plain has an elevation of 50 to 60 feet. Through it the Delaware has cut a wide valley, the flood-plain of which is now less than ten feet above sea-level. The relation of the flood-plain to the plain above shows that, after the latter was made, the river excavated a valley in it, cutting it down essentially to tide-level. This valley has been cut since the last glacial epoch.

* Paper presented at the summer meeting of the American Association for the Advancement of Science.

The gravel plain to the east and north of the point where the finds are made ends abruptly at the margin of the post-glacial valley, in a bluff about forty feet in height, with a slope which is about as steep as the material of which it is composed will lie.

The relations shown on the New Jersey side of the river are in a general way duplicated on the Pennsylvania side. The gravel of glacial age has a similar disposition, but the border of the valley on that side is not so sharply defined, indicating that the more recent cutting of the stream has been on the east. The steepness of the bluff of gravel at the points concerned is in itself proof of the recency of the excavation on this side.

The surface of the plain is slightly undulatory, though the relief is usually but a few feet. In places erosion has affected it to some slight extent, and in places its surface appears to have been left slightly uneven by the deposition of the material of which it is made. Its surface is also characterized at various points by low mounds and ridges of sand heaped up by the wind. By this means an element of undulatoriness has been added to the surface as originally left by the deposition of the main body of sand and gravel involved.

While the plain consists of sand and gravel, so far as its general constitution is concerned, its surface is in many places coated with a thin layer of sandy loam, which contains occasional pebbles similar to those which make up the body of the gravel beneath. It is not always possible to say to what extent the surface loam represents the last stage of deposition of the glacial sands and gravel; to what extent it represents the surface accumulation of loamy matter brought up from lower levels by the action of biotic agencies, such as worms, ants, burrowing mammals, etc.; or to what extent it represents deposition by marine or estuarine waters which stood over the region after the glacial drainage ceased to flow through this part of the Delaware.

Relations similar to those where the human relics just south of Trenton are found characterize the east side of the Delaware for many miles further south. In this direction materials derived from glacial waters are less readily identified at most points, but the topography and relations of the plain bordering the Delaware are such as to show that it was developed contemporaneously with the plain at Trenton. Even where not made up chiefly of glacial materials, the plain further south, like that at Trenton, is slightly undulatory, and is coated, in places, with dune sand. Such sand is especially likely to be found on the west edge of that part of the plain which lies east of the Delaware, and just east of the line where the plain descends with a bluff face to the flood-plain of the stream. Well-marked dunes sometimes appear in this situation, and dune sand in larger or smaller quantity is so general that its presence along the edge of the plain above the valley may be said to be the rule, rather than the exception, between Trenton and Camden.

The same is true of the tributaries which come down to the Delaware from the east. Although they did not bring down glacial sands and gravels, they brought down sands and gravels of other sorts, partially filling their valleys, which, like the Delaware, have been re-excavated since. On the bluffs of the tributary valleys, as well as along the main stream, dune sand is of frequent occurrence. In the dune sand along these tributaries, relics of early peoples, consisting of chips of argillite, arrow-heads, and half-fashioned tools of various sorts, are frequently found.

Sand is found in similar relations at some points on the Delaware above Trenton. At many points it has been blown up from the

glacial gravel terraces to higher levels, though it rarely takes the forms of distinct dunes. It is frequently three to five feet in depth, facing the bluffs above the glacial plain in irregular patches, or capping their crests.

The trenches in which the human relics near Trenton have recently been found are upon the immediate edge of the plain overlooking the post-glacial valley of the Delaware. Here, as is frequently the case in such situations, the sandy loam over the gravel of glacial age is thicker than farther back from the bluff, but even here it is but three or four feet in thickness, including the black soil. It is in this sand and loam, quite above the materials which are clearly of glacial age, that the human relics are found.

In detail the sections shown in the trenches open in May and July showed a sandy soil affected by organic matter to the depth of six to twelve inches, the lower limit being ill-defined. The soil graded down into sand which was essentially free from organic matter, and which had a thickness of two to three feet. The sand was without apparent stratification. Below it lay the stratified drift, confidently referred to the time of the last ice epoch. It will be seen, therefore, that the relics were found in the structureless sand and loam which overlay the sand and gravel of glacial age.

Besides being essentially structureless, the sand and loam in which the relics were found contained occasional pebbles. Some of them were as large as one's fist, and occasionally one was found of still greater size, though most of them were tiny pebbles. Many of them were so small as to be within the power of wind to transport, while others were so large as to make this mode of transportation impossible.

In the sand there were at some points streaks more highly colored than the portions above or below. These streaks had a position approaching horizontality, but in detail they were exceedingly irregular. Locally they were interrupted, apparently broken; and in other places they faded out altogether. In general they were thin, a trifling fraction of an inch in thickness. They were sometimes so faint as to be traceable with difficulty, while in other places they thickened to a quarter of an inch or more. While these streaks were often distinct, they were not to be mistaken for lines of stratification, with which they clearly had nothing to do. They could not be assumed to be the edges of stratification plains distorted by unequal sinking, for if this were their origin successive streaks in the same vertical section should have corresponded in their irregularities. This was not the fact, for one streak was liable to bend up just where the one a few inches below it bent down, a relation which excluded the idea of unequal settling. Furthermore, they were so irregular that their total length, as seen in the face of a trench, measuring all irregularities, was considerably greater than the length of the section itself.

These reddish streaks, which were thought to carry more pebbles than the other portions of the sand, seemed to be due to one or more of two or three causes. In places they seemed to be due to the concentration of coloring matter, especially iron oxide. In other places they looked rather as if fine reddish silt had accumulated along them through the influence of percolating water. In either case there must have been something in the texture along this irregular surface to occasion the concentration. The surface of which these irregular lines were the outcrops may perhaps once have been the upper surface of the land, subsequently buried by wind-blown dust and sand. Many of the little irregularities of the streaks were such as might be thus explained, though

the abrupt breaks in them must be accounted for in some other way. So far as I could make out, there was nothing except these reddish streaks which could by any possibility be mistaken for structure, and had I not known at the time of my second visit that they had been taken by others for stratification plains, I should not have supposed this interpretation a possible one.

Concerning the age and origin of the sand which contains the relics, no positive affirmation can be made, and it is only fair to say that this statement is made on the basis of a somewhat full knowledge of the surrounding region. So far as its stratigraphic relations are concerned, the relic-bearing sand might represent the last phase of deposition by glacial waters, or it might belong to any later epoch. Its absence of structure does not show that it was not deposited by water, for in the nature of the case it could not now be expected to show structure, whatever its origin. This would be true whether it represents (1) the last phase of deposition by glacial waters, (2) an estuarine deposit of later age, or (3) eolian sand; for the continually renewed perforation of the sand to the depth of several feet by the roots of plants, the continual borings of burrowing mammals, worms and insects, all of which frequently go down to the bottom of the sand overlying the gravel of glacial age, would quite certainly have destroyed all traces of stratification which the sand may once have had. If this were not enough, the freezing and thawing, and the wetting and drying, would have completed the obliteration of any original structure. For this result even a very few centuries would suffice. It cannot be asserted, therefore, that the sand was not once stratified.

On the other hand, the sand in which the relics are found may have been blown to its present position. The fact that the immediate edge of the bluff is slightly higher than the plain farther back lends color to this view, but the rise next to the edge of the bluff is very slight, and the conclusion that it is due, at this particular point, to an accumulation of wind-blown material is not necessitated. The explanation of eolian sand in this position would be easy. While the river was cutting its valley in the plain, the bluffs were bare. The bare face of the bluff was made of loose sand and gravel, and the prevailing westerly winds might well have blown sand from the slope to the top of the bluff above. This is just the situation in which dune sand would be expected to accumulate under such circumstances, is indeed just the situation in which it has accumulated at many other points along the Delaware and its tributaries. It is probably not exaggeration to say that dune sand occurs in greater or less quantity along the Jersey side of the river, more than half the way between Trenton and Camden, and throughout the stretch its favorite position is on the edge of the river bluff. The dune sand along the tributaries to the Delaware between Trenton and Camden occurs in the same relations. The very general presence in the region of wind-blown sand on the crests of valley bluffs leads one to suspect the same origin for sands in similar situations, such as that in which the relics are found, even when they cannot be proved to be eolian. The case is still further strengthened by the fact that human relics are very generally found in the sand which is demonstrably eolian.

In the presence of the stones there is an apparent difficulty in the way of ascribing the sands in question to the wind. If, however, the sands were accumulated by the wind after the occupation of the region by early peoples, the larger stones may have been dropped by men upon the surface at the same time with the argillite chips and half-fashioned implements, while the smaller ones might have been blown in. But we

are not shut up to this conclusion. There are various other ways in which pebbles might be introduced into eolian sand. The burrowing animals and the growth and decay of the roots of trees might introduce relics and stones from the top, if they were left by men on the surface. Relics of modern civilization, bits of coal, pieces of brick, etc., were found in the sand down to a maximum depth of seventeen inches. The uprooting of considerable trees might bring up gravel stones of considerable size from depths of several feet into the surface material. If forest trees were ever upturned by winds in this locality they could not fail to bring up pebbles into the sand above the gravel. The breaks in the streaks already referred to might find explanation in such disturbances. In view of these possibilities the presence of the pebbles in the sand cannot be asserted to prove that it is not of wind origin.* Finally, it is believed that no unqualified conclusion concerning the origin of the relic-bearing sand is warranted. It may be of aqueous origin, dating from the close of the last glacial epoch; it may be of aqueous origin of later age, for sea water probably covered the region at the close of the last glacial epoch or later; and it may be eolian, dating from a time long subsequent to the deposition of the sand and gravel of the plain.

Whatever its origin, it may safely be said that the surface material down to the lowest depth at which the relics have been found has been so disarranged that no affirmation can be made concerning the origin of the pebbles and relics it contains. It is all within the zone of active weathering and surface disturbance. If the finds were fossils, in the usual sense of the term, it is certain that geologists would not feel warranted in attaching much importance to them.

*My co-laborer in New Jersey, Mr. George N. Knapp, visited the locality where the relics are found in June, and reached the conclusion that the sands in question are eolian. No one else has more intimate familiarity with these sands than he.

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SANARELLI'S WORK UPON YELLOW FEVER.

AT the request of the editor of SCIENCE I append a brief *résumé* of Sanarelli's recent papers upon yellow fever.*

The most important study of yellow fever that appeared before Sanarelli's investigations were undertaken was that made in 1888–9 by Dr. Sternberg, whose researches led to an essentially negative result. Upon only one microörganism found by him in the course of his thoroughgoing investigations did any degree of suspicion fall, and the evidence against this germ was summed up by Sternberg as follows:

"Among the facultative anaërobics is one—my Bacillus X—which has been isolated by the culture method in a considerable number of cases and may have been present in all. This bacillus has not been encountered in the comparative experiments made. It is very pathogenic for rabbits when injected into the cavity of the abdomen.

"It is possible that this bacillus is concerned in the etiology of yellow fever, but no satisfactory evidence that this is the case has been obtained by experiments on the lower animals, and it has not been found in such numbers as to warrant the inference that it is the veritable infectious agent.

"All other microörganisms obtained in pure cultures from yellow fever cadavers appear to be excluded, either by having been identified with known species, or by having been found in comparative researches made outside of the area of yellow fever prevalence, or by the fact that they have

*Annales de l'Institut Pasteur, June, September, October, 1897.

been found only in small numbers and in a limited number of cases."

Sternberg has recently called attention* to the close similarity between his description of the 'Bacillus X' mentioned in the above quotation and the description of '*B. icteroides*' given by Sanarelli, and makes out a strong case for the view that the two are identical.

Sanarelli began his work in February, 1896, shortly after his appointment as Director of the Institute of Experimental Hygiene at the University of Montevideo. In 7 out of 12 autopsies made by him upon the bodies of victims of yellow fever there was found a specific bacillus (*B. icteroides*) which he regarded as hitherto undescribed. The reasons assigned for the failure of himself and others to isolate this microbe in all cases of yellow fever are: 1. That *B. icteroides* multiplies in the human body only to a limited extent, the complete and characteristic effects of the disease being produced by only a very small quantity of toxin. 2. That this toxin, whether directly or indirectly, facilitates to a remarkable degree secondary infection of all kinds. These secondary infections with the colon bacillus, streptococcus, staphylococcus, etc., may of themselves be fatal to the patient, and Sanarelli believes that the fatal termination or several cases observed by him is to be explained in this way. 3. That these mixed infections not only lead to the speedy disappearance of the specific microbe, but also frequently end by transforming the organism of the patient into a culture medium for almost all kinds of intestinal bacteria.

The bacteriological complications arising from these facts enhance considerably the technical difficulties of isolating the specific bacillus. Sanarelli did not succeed in finding the germ in the gastro-intestinal contents and is inclined to doubt if it usually occurs there at all; he did, however, discover it in the circulating blood and in some of the important organs of the body, notably in the liver. He refers to the prevailing belief that the infectious material in yellow fever is localized in the stomach and is to be sought for especially in the black vomit, but prefers, for his part, to regard the gastric disturbances as due to the selective action of the toxin, a view similar, it will be remembered, to his interpretation of the intestinal lesions of typhoid fever.

Bacillus icteroides grows readily upon the ordinary nutritive media, fluid and solid. It is described as a rod about 2μ–4μ in length, with rounded ends, often joined in pairs, and staining readily with the ordinary aniline dyes, but decolorized by Gram's method. The colonies upon a gelatin plate resemble in some particulars those of the colon bacillus, but never show any trace of the chestnut color developed in cultures of the latter; so-called pleomorphism of the colonies is, however, marked.

Contrary to what is true of most of the known pathogenic microbes, the growth of *B. icteroides* upon agar is especially characteristic and furnishes a diagnostic test of the first importance. If the cultures are allowed to develop in the incubator at 37° for from 12 to 24 hours, and are then transferred to a temperature of from 20° to 28°, there is produced what Sanarelli regards as a highly characteristic appearance. The growth at the lower temperature forms a sort of halo around the portion of the colony developed in the incubator, and this appearance is so singular that according to Sanarelli a mere superficial inspection suffices to distinguish immediately, and with the naked eye, a colony of *B. icteroides* in the midst of all other bacterial colonies yet described. As the growth goes on, an effect is produced as if a layer of opaque paraffin had been poured over the agar and then impressions made in it with a small circular seal, the imprints of this seal corresponding with

* *Centralbl. f. Bakt.* I. Abth. XXII., Nos. 6 and 7.

the original transparent colonies grown in the incubator. The final aspect of the culture is compared to a miniature archipelago in which the islets would be represented by the colonies first developed, and the surface of the water by the layer subsequently formed at the lower temperature.

Blood-serum and potato proved themselves to be rather unsuitable media for *B. icteroides*. In milk the germ grows readily, but without producing coagulation. The most favorable fluid medium tested by Sanarelli was beef broth containing lactose and calcium carbonate.

The germ is pathogenic for most of the domestic animals. Mice, guinea-pigs and rabbits succumb readily to inoculation with a pure culture. The rabbit is considered as the most favorable subject for experimental inoculation, and possesses notable advantages over the guinea-pig both in susceptibility and in the regularity and constancy of symptoms and death. The dog, however, presents the most instructive instance of close analogy with the disease yellow fever as it manifests itself in man. Both in the symptoms and in the anatomical lesions Sanarelli was able to trace a correspondence at once constant and precise. As is the case in man, the liver and the kidneys are the organs especially attacked; secondary infections with the streptococcus and colon bacillus sometimes occur.

In the second memoir Sanarelli details the results of his experiments with the yellow fever toxin. Cultures of the germ 15–20 days old, made in ordinary peptonized meat broth and filtered through a Pasteur-Chamberland tube, afforded him a potent toxin. The toxin thus prepared, when injected into the bodies of susceptible animals, produced substantially the same symptoms as inoculation with the specific bacillus. In the dog, particularly, inoculation with the germ-free toxin set in motion the same train of specific symptoms and caused the same pathological changes in the tissues. "The toxin of yellow fever is an exceedingly powerful cellular poison comparable solely, in some points, to the diphtheria toxin. Its contact with the tissue elements of the animal organism, especially the higher species, determines, like that of the diphtheria toxin, a violent irritation, followed by retrogressive processes which always end in the necrosis and fatty degeneration of the protoplasm."

Some very interesting experiments bearing on the question of mixed infection are next described. When *B. icteroides* in sown upon culture media on which, respectively, the colon bacillus, streptococcus and proteus have been previously grown, it is found that the growth of the former is distinctly inhibited by the presence of the soluble products of the other microbes. The latter, on the contrary, grow excellently in a medium previously inhabited by *B. icteroides*, and are only slightly incommoded by the presence of the soluble products of one another, the products of the proteus bacillus seeming most injurious to all concerned. A similar result was revealed by a study of the 'vital antagonism' of *B. icteroides* and the microbes concerned in the secondary infections. Both *streptococcus pyog.* and *staphylococcus pyog. au.* speedily gain the upper hand over *B. icteroides*, and a similar, though less marked superiority, is manifested by the colon bacillus. These facts certainly shed much light on the difficulty of demonstrating the presence of the yellow fever germ in the bodies of victims of the disease, and go far to explain the negative result reached by many observers.

In an attempt to account for the important part played by maritime commerce in the diffusion of yellow fever Sanarelli records a curiously significant observation. It was noticed that gelatin plates sown with *B. icteroides* sometimes remained without development, although agar plates sown at the same time evinced abundant growth. But

if a colony of mould made its appearance on the gelatin plate, colonies of *B. icteroides* immediately sprang up around it. After some days the colonies of *B. icteroides* form a sort of constellation around the mould, the most abundant development taking place in the immediate neighborhood of the latter. This observation was experimentally verified with six species of moulds (not named) 'accidentally isolated' in the laboratory, all of which proved themselves, although in different degrees, capable of favoring the revivification and multiplication of the yellow fever germ. To this singular symbiotic relation Sanarelli is inclined to attribute the ready domiciling of the disease on shipboard and its connection with warmth, moisture and darkness, conditions which, by directly favoring the germination of moulds, indirectly favor *B. icteroides*.

In some brief notes upon the resistance of the germ to physical and chemical agents it is stated that, by exposure of broth cultures to 55°, the germ is killed in about twenty minutes, and that it is instantly destroyed by a temperature of 65°. Dry heat at 110°–125° is speedily fatal, and exposure for one hour and ten minutes at 100° also suffices to destroy vitality. Considerable resistance is shown to desiccation, a result of evident practical importance. In sea water the bacillus shows great vitality, surviving in the sterilized brackish water of the La Plata for upwards of ninety days.

Sanarelli's third memoir is devoted to a consideration of immunity and serum therapy. The serum obtained from the bodies of yellow fever victims causes agglutination of *B. icteroides*, although the intensity of the reaction is said to be quite variable. This serum does not exert any protective power in inoculated animals. Serum from a convalescent provoked a tardy agglutination and manifested a slight preventive power.

An attack of yellow fever in man confers some degree of immunity against a second attack, and hence it would seem as if it might be possible in some way to vaccinate animals against the disease. Attempts to produce immunity in the rabbit failed on account of the excessive sensibility of this animal to the yellow fever virus, and the same difficulty prevented the use of the goat and the sheep. The work upon immunization was mainly limited, therefore, to experiments upon the guinea-pig, the dog and the horse. In all these animals immunization is an unusually difficult and laborious task. While it is possible to immunize a guinea-pig against cholera or typhoid fever in from two to three months, it needs six to seven months of assiduous and delicate work to vaccinate this animal against yellow fever. Dogs may be immunized somewhat more readily, but never become tolerant of large doses of toxin. Horses are treated first with small doses (5–10cc.) of a filtered culture of the germ injected subcutaneously, followed with intravenous injections. After two months of treatment with filtered cultures the more potent doses of cultures sterilized by ether may be used; it is not until five to six months after the beginning of the treatment that the first injection of a living culture may be safely hazarded. During this process of immunization many of the animals die and all are profoundly affected.

The serum of animals immunized in this way is endowed with protective and curative properties and can be used with success in animal experiments. A single instance may serve to illustrate the results obtained by this procedure. A horse under treatment for the space of nine months received subcutaneously during this period 29cc. of filtered cultures and 350cc. of cultures sterilized with ether, and intravenously 2640cc. of sterilized cultures, 345cc. of living broth cultures and 19cc. of an agar culture. The serum (0.5cc.) from this

animal, when injected into a guinea-pig 24 hours before inoculation with several times the fatal dose, conferred immunity; 2cc. proved potent enough to save the lives of guinea-pigs when injected 48 hours after inoculation.

Sanarelli's work upon immunization was still in progress when the third memoir was written, and the outcome of his projected experiments in serum-therapy will be awaited with much interest.

EDWIN O. JORDAN.

LUDWIG RÜTIMEYER.

ON the 25th of November, 1895, died at Basle Ludwig Rütimeyer, the last survivor of a long series of Swiss naturalists, the representatives of the classic period of natural science in this country. Now, two years after the death of this distinguished naturalist, his miscellaneous papers appear in a form capable of attracting the attention of the scientific world.* Rütimeyer's numerous publications, which for a long time chiefly adorned the 'Abhandlungen der schweizerischen palæontologischen Gesellschaft' and the 'Denkschriften der schweizerischen naturforschenden Gesellschaft,' could not be reproduced, but the smaller occasional lectures and writings, which, owing to the astonishing universality of Rütimeyer's researches and studies, deal with questions of zoology and anthropology as well as of geology and geography, are here collected in two volumes. It is well known what a high position the leader of European paleontology, von Zittel, has assigned, for example, to Rütimeyer's paper on the geographical and geological distribution of animals. Whoever shall read this and the similar papers made accessible by this edition will be surprised by the perspicacity of the conclusions and the abundance of openings in every direction of natural philosophy, the exceeding originality and the immense knowledge of details which characterized the man, to whom in the last decades, along with Sir Richard Owen, Vertebrate Paleontology in Europe is most indebted. Among the fundamental questions of zoology we find treated the principles of natural history, the boundaries of animal life, the phylogeny of the vertebrate skeleton, the changes in animal life in Switzerland since the presence of man, the modality of progress in the organic world, general considerations on the sectonic structure of Europe, history of glacier studies in Switzerland, three essays on the Bretagne and addresses in the memory of L. Agassiz, Ch. Darwin, P. Merian and B. Studer, who were in intimate relations with Rütimeyer. The first volume is introduced by an autobiographical sketch, which may give to American naturalists an idea of the development, the many suggestions and difficulties of a Swiss who devoted his life to natural philosophy.

RUD. BURCKHARDT.

BASEL, December 1, 1897.

* 'Gesammelte Schriften.' Basle, Georg et Cie. 1898.

CURRENT NOTES ON PHYSIOGRAPHY.*

THE GLACIAL LAKE AGASSIZ.

As the Monographs by Gilbert and Russell on the extinct Lakes Bonneville and Lahontan are the classics with regard to basins from which former bodies of water have been withdrawn by evaporation, so

* In SCIENCE for December 3d it was implied that the recent report of the Maryland Geological Survey had neglected possible relations with the schools of the State and devoted its physiographic studies to the interests of 'those who may seek a home in Maryland.' This error was due to my eye having caught the heading 'Study of the Pysiographic Features of the State' (p. 40), in which only the immigrant is referred to as taking advantage of the results; while I failed to note, under the heading 'Preparation of Final Reports,' a very explicit mention of their educational significance. "It is most desirable that the youth of Maryland should grow up with a knowledge of the country in which they live, and be

Monograph XXV. on the Glacial Lake Agassiz, by Warren Upham (U. S. Geol. Survey, Washington, 1895) at once takes its place as a standard work regarding one of those remarkable water bodies which for a time flooded an area marginal to the retreating ice sheet. A great fund of detailed description is here added to the reports already published by Upham and others, regarding the Red river plain, outlets, shore lines, deltas, etc. It is important to note that large areas of the plain at its south end and along either side are mainly composed of unstratified till, and that only the medial part of the plain is covered by lacustrine silts. The plain, therefore, should be classified not only under lacustrine plains, but also under plains of till; the latter species being until recent years unmentioned in text-books. An intricate lacustrine history is revealed by the complicated succession of shore lines which varied with gentle epirogenic movements, and by the changes of discharge from the southern outlet to some more northern lines of overflow. Maps and views are liberally provided. As has been the case with many other phases of glacial study, it is remarkable to discover how largely the existing physiographic conditions of certain regions are dominated to-day by processes associated with glacial action. Yet until very lately our physical geographies gave practically no attention to land forms of glacial origin. This neglect cannot long continue in face of so fine a collection of examples as this great monograph contains.

able to interpret intelligently the physical features of the State." If the people of the State desire it, material adapted for purposes of public instruction will be provided in future volumes.

Having for some years believed that our State Surveys lost a valuable opportunity of serving the public good, and of gaining sound public support by their general neglect of relations with the public schools, I am glad now to make explicit correction of my former note on the Maryland Survey in this regard.

VOLCANOES OF NORTH AMERICA.

Following the plan of his volumes on Lakes and Glaciers, Russell has completed a valuable work on the Volcanoes of America, 'a reading lesson for students of geography and geology' (Macmillan, 1897, p. 346, many plates). A third of the book is given to characteristics of volcanoes, presenting an excellent summary of the subject, excepting that 'erosion of volcanoes' is, for a geographical book, too briefly dismissed in four pages, as compared to thirty pages allotted to products of volcanic action. The descriptive chapters on the volcanoes of different districts summarize the results of our Western surveys, where Russell's own observations play no unimportant part, and abstract many accounts not generally accessible, such as those concerning the explosive eruption of Conseguina, the building of Jorullo, the recent explorations of the lofty Mexican cones, and the surveys of the Alaskan islands. The dissected cones and heavy lava beds of the Yellowstone Park are not mentioned. A chapter of theoretical considerations explains the ascent of lavas from their deep sources chiefly as an escape from the pressure of the enclosing crust, and characterizes steam explosions as relatively superficial incidents instead of prime causes of eruption. A final chapter gives the life history of a volcano. The illustrations are numerous and excellent.

LAKES IN HIGH MOUNTAINS.

E. Fugger has an article on *Hochseen* (Mitth. Geogr. Gesell. Vienna, XXXIX., 1896, 638–672), in which he gives especial attention to the small lakes occurring in the Karen (corries, cirques, amphitheatres) of the Salzburg Alps, the 'normal lakes' of high mountains. He discards the explanation by glacial erosion maintained by Böhm and many others, and Richter's modification of this explanation, where drift ob-

struction is called to the aid of simple excavation. After showing that corry lakes are true rock basins and that local deformation cannot account for them, Fugger advances the idea that they lie in funnel-shaped cavities that once led down to subterranean channels opened by solution, but now obstructed; even advocating this explanation in corries of crystalline rocks, and defending it by a rather elaborate physico-chemical argument.

Apart from the general difficulty of believing in the sufficiency of underground solution in resistant rocks, it seems impossible that erosion thus determined could exceed that effected by the active streams that descend the steep slope on the open sides of corries. As the problem is presented by the writers mentioned above and by various others, glacial erosion seems to be the most competent cause for corry lakes.

THE 14000 MALDIVE ISLANDS.

THE rarely visited Maldive archipelago is described in an interesting article by Rosset (Mitth. Geogr. Gesell. Vienna, XXXIX., 1896, 597–637). The islands are all of coral formation, seldom more than two meters above sea level, with much unhealthy swampy surface. They are seldom more than a few miles in diameter. More than a hundred islets may form the circumference of a single atoll, and sometimes the individual islets themselves have a ring-like, atoll form. The seaward submarine slopes are steep; the shores are attacked by heavy surf, and the natives believe that the land area is decreasing. The islands are separated by deep passages through which strong currents run one way or the other according to the monsoon season. Many channels breach the reefs and give access to quiet anchorages in the lagoons. The colors about an atoll vary from the purple waters off shore to the green, shallow water, the white coral strand, the olive brown reef with dark green vegetation, and the bright green lagoon. A description of the people and their history follows.

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CURRENT NOTES ON ANTHROPOLOGY.

ELEMENTS OF MELANESIAN ART.

AN article of prime value to students of early art and to anthropologists in general is that by Dr. K. Th. Preuss, in the *Zeitschrift für Ethnologie*, 1897, Heft III. and IV., on the artistic designs of the natives of Kaiser Wilhelms Land, New Guinea. The material he had at his command was a collection of over five thousand specimens now in the Museum of Ethnography, Berlin. He considers it practically complete, presenting the world of their art in line and figure. His article is illustrated with 199 figures in the text, yielding ample means for studying the leading motives of these savage artists. The analysis of their favorite forms is traced out with masterly precision, and as one follows the author in his unraveling the strange and intricate figures he copies, no doubt is left of the success of his undertaking.

In some introductory pages he refers to the bearing of such studies on the question of transmission or independent origin, and on the tendency of primitive man to copy from nature and to conventionalize his copies. Several popular impressions are corrected and sounder methods of comparison explained.

THE EXTENSION OF THE ARAWACK STOCK.

THIS stock of South American languages has peculiar interest, as it is that which spread over the West Indian Archipelago and the Bahamas at some remote date; and if any of the native languages of our Gulf States had South American affinities, they should be looked for in the Arawack and not

in the Carib dialects, as the latter never approached nearer than the south of Cuba.

In the *Zeitschrift für Ethnologie* 1897, Heft II., Dr. Paul Ehrenreich contributes new materials to the tongues spoken on Purus river by the Paumari, Ipurina, Araua and Yamamadi tribes, showing that these are branches of this widespread stock. He remarks : "From the islands of the Antilles far south to the sources of the Paraguay and Madeira rivers, one can now follow an almost unbroken line of Arawack dialects, in which, in spite of the great distance of more than thirty degrees of latitude, it is easy to show a complete grammatical identity."

This is another example of the general fact that the extension of accurate research is rapidly diminishing the number of South American linguistic stocks.

THE ALLEGED SUMMERIAN LANGUAGE.

THE Summerians, so-called, inhabited southern Babylonia about 5,000 years B. C. Their northern branch are known as 'Akkads.' Some say that they spoke a tongue allied to the Semitic stock, while other authorities have maintained that the sufficiently abundant remains of this very ancient idiom show marked analogies to the Ural-Altaic tongues. The latest advocate of this opinion is Dr. K. A. Hermann, of Dorpat, who, at the tenth Russian Archæological Congress, urged strongly that the Summerian had the same construction, vocal harmony and phonetics as the Finnish-Ugrian branch of the Ural-Altaic stock.

In his paper, as reported in the *Centralblatt für Anthropologie*, Dr. Hermann fails to note the objections urged by the eminent Ural-Altaic scholar, Dr. Hugo Winkler to the supposed similarities of Summerian to Ugro-Finnic tongues. These objections are so cogent that they must be held conclusive for the negative. The Summerian, if it was not Semitic, which is still possible, may have been Dravidian, or even a very primitive Aryan idiom. Either of these is more likely than the Ural-Altaic hypothesis.

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SCIENTIFIC NOTES AND NEWS.

THE WINTER MEETINGS OF THE SCIENTIFIC SOCIETIES.

THE societies meeting at Ithaca as we go to press represent perhaps the most important attempt to bring the sciences into fruitful relations now existing in America. The National Academy of Sciences and the American Association for the Advancement of Science are more important organizations. They have done more for science in the past, and it may be that they will do more in the future. The National Academy, however, at the present time does not exert a great influence. At a recent session there was only one person present in addition to about twenty members, and each of the papers presented was only of interest to two or three of the members. There was not a line regarding this session in the daily papers of the city in which the Academy met, and it was, perhaps, referred to nowhere except in this JOURNAL. The American Association has during the past ten years had at its annual meetings an average attendance of only about four hundred members with a tendency to decrease. These have by no means been exclusively the four hundred most competent men of science in America, and the total work of the Association has been disappointing. We may hope for much from the anniversary meeting at Boston next year, but it must be acknowledged that at present the Association is in a position to need help from scientific men rather than to give help to them.

The associations devoted to a single science meeting during the Christmas holidays—the Mathematical Society, the Geological Society the Chemical Society and the affiliated societies concerned with the biological sciences convening at Ithaca—are doing their work with thoroughness and with fruitful results. We miss a physical society, but otherwise each of the leading sciences is represented by a well or-

ganized association which is contributing its share to scientific advance. The Society of Naturalists and the affiliated associations are, perhaps, of especial interest because they represent an attempt to keep a group of sciences in mutually helpful relations. Each society has its own organization and special work, but men of science in different but related departments are brought into personal contact, so that each may learn to appreciate the work of the others. The programs of the different societies promise that the meetings this winter will be of special interest, and we are sure that this promise will be confirmed by the reports to be published in this JOURNAL.

THE ECLIPSE EXPEDITIONS FROM GREAT BRITAIN.

ACCORDING to the London *Times* a considerable rearrangement has been made of the stations proposed to be occupied by the various British parties setting out to observe the total eclipse of the sun on January 22d. Sir Norman Lockyer will, as before arranged, occupy the most westerly of these stations—at Viziadrug, on the coast of India. The next station towards the east is where the Southern Mahratta Railway crosses the central line of totality near the station of Karad. Here Professor Michie Smith, the government astronomer at Madras, with his party, will take up his position. The Great Indian Peninsular Railway crosses the central line about 100 miles farther east at Jeur. Here Professor K. D. Naegamvala, the curator of the observatory of the Royal College of Science, Poona, with a large party of resident observers, will be encamped. A wide interval separates this station from the next, which will be occupied by a party sent out by the British Astronomical Association. This will consist of Mr. John Evershed, Mr. and Mrs. E. W. Maunder, Captain P. B. Molesworth, R.E., and Mr. C. Thwaites. This party is travelling out by the P. and O. steamer Ballaarat. Their camp will in all likelihood be pitched at Talni, on the line between Amraoti and Nagpur. Near them will be the second of the official parties sent out by the joint committee of the Royal Society and the Royal Astronomical Society, Sir N. Lockyer's party forming the first, and consisting of Captains Hills, R.E., and Mr. Newall. Mr. Newall has already started, and Captain Hills will travel by the P. and O. steamer Oriental. Another 120 miles along the shadow track the third official station will be occupied by Dr. Copeland, Astronomer Royal for Scotland, on the high road between Nagpur and Seoni; whilst the fourth party, consisting of the Astronomer Royal (Mr. W. H. M. Christie) and Professor H. H. Turner, of Oxford, who also travel by the Ballaarat, is expected to be located at Sohagpur, on the line from Jubbulpore to Bilaspore, some 150 miles from Dr. Copeland. Finally, the second party of the British Astronomical Association, which will be under the leadership of the Rev. J. M. Bacon and will go out by the Egypt, is expected to take up its quarters for the eventful day at Buxar, on the Ganges, some 220 miles farther on. With the favorable meteorological conditions which prevail in India in January and this wide distribution of observing forces, it is to be hoped that no such severe disappointment as was felt in Norway and Japan during the eclipse of last year will be experienced on this occasion.

GENERAL.

As we go to press we receive intelligence of the important discovery announced by Professor J. C. Kapteyn, of Gronigen, that the Star Cordoba Zone Catalogue 5^h. 243 has a proper motion of $8''7$ on arc of a great circle. The largest proper motion hitherto known is that of 1830 Groombridge — $7''0$ on arc of a great circle.

AT the session of the Academie des Sciences held at Paris, December 13, 1897, the Cuvier prize of 1,500 francs was awarded to Professor O. C. Marsh, of Yale University. This prize 'is awarded every three years for the most remarkable work either on the Animal Kingdom or on Geology.'

THE post of Government Botanist of Victoria, vacant by the death of Baron von Mueller, has been filled by the appointment of his former assistant, Mr. J. G. Luehman.

A CABLEGRAM reports that the will of Dr. Thomas W. Evans, the opening of which has been awaited with much interest, leaves nearly

his entire estate, estimated at $8,000,000, for the Thomas W. Evans Museum and Institute of Philadelphia. Further details are lacking.

DR. T. PORTER, whose herbarium was reported to have been destroyed by the recent fire in Pardee Hall, Lafayette College, has made the following statement: "The Pennsylvania flora is saved entire and complete. It is the best in existence, and I am greatly relieved. I have labored a lifetime on it. The collection of North America is saved to the extent of a little more than two-thirds; much that appeared utterly destroyed Saturday proves not to be so badly damaged as to be valueless. The offers of my friends in all directions which are coming in on me like a blessed shower will enable me to restore the collection. I am deeply touched by their generous sympathy and aid."

THE Harvard Natural History Society celebrated on December 17th its sixth anniversary. Professor Shaler gave an address on the history of the Society, and William T. Hornaday, of the New York Zoological Society, lectured on the preservation of our native birds. The Society now numbers over seventy members and has recently been organized into sections for the various branches of natural history.

THE sixty-sixth annual meeting of the British Medical Association will be held in Edinburgh from Tuesday, July 26, to Saturday, July 30, 1898. Since the Association met in Edinburgh twenty-three years ago many changes have taken place in the medical institutions of the city, and the Association will next year be able to meet in McEwan Hall, the magnificent new building of the University of Edinburgh.

THE deaths are reported of Dr. Friedr. Wilhelm Snyder, the botanist, at Braunsberg, at the age of 87 years; of Professor Raphael v. Erlanger, the zoologist, at Heidelberg, aged 33 years; of Dr. Wilhelm Joest, the explorer, in Australia; of Mr. Samuel A. Miller, of Cincinnati, the author of numerous contributions to zoology and paleontology, on December 19th, aged 61 years; of Dr. F. C. Schneider, emeritus professor of chemistry in the University of Vienna, aged 84 years, and of Dr. Schrauf, professor of mineralogy in the University of Vienna, aged 60 years.

WE are requested by Professor I. P. Roberts, Director of the College of Agriculture of Cornell University, to call attention to the university extension work in agriculture, provided last year by the Nixon Bill and placed under the direction of the College of Agriculture. The object of the work is the promotion of agricultural knowledge in the State. A reading course class has been organized for the study of some of the fundamental principles which underlie agriculture, and this study may be taken up at the farmers' homes. Those wishing to join the class, now numbering several hundred, will receive, free of cost, printed matter for study which will be followed by questions intended to lead to a discussion of any points not well understood by the pupil.

THE Société des Laboratoires Bourbouze, of Paris, offers scientific courses to workingmen, free of charge, on Sunday from nine to eleven o'clock. Physics and chemistry will be taught in the laboratories, the courses being adjusted to the practical needs of the students.

DECEMBER 5th was the sixth anniversary of Museum Sunday, instituted in Great Britain by the Sunday Society in 1892. About one hundred institutions were opened on that Sunday. The attendance at the British Museum was 458, and at the Natural History Museum 554. These numbers are scarcely as large as might have been expected.

THE United States Civil Service Commission announces that the examination which was scheduled to be held at Washington and elsewhere on January 8th, for the position of Computor in the Nautical Almanac Office, has been postponed to January 10th and 11th, it being found that it will be necessary to give two days for the examination. Very few applications have as yet been received for examination for this position. All persons desiring to compete should write to the Commission at once for application blanks and information.

PROFESSOR GABRIEL LIPPMANN, who was recently awarded the 'Progress' Medal of the Royal Photographic Society for 'Photography in colors by the interference method,' read a

paper on the subject before the Society on the 14th of December.

WE announced recently that the American Forestry Association would hereafter publish a journal devoted to the interests it represents. *Garden and Forest* states that the Association will take *The Forester*, founded and for the past three years edited by Mr. John Gifford, Princeton, N. J. The new office of *The Forester* will be at No. 73 Cochran Building, Washington.

THE Report of the Director of the Field Columbian Museum for 1896–7 reflects much credit upon the Museum staff, showing that a large amount of work has been accomplished by a small force and that good progress has been made in caring for the study series as well as in installing the exhibits. The report contains a number of plates showing the methods of installation in the various departments. The 'monographic installation of North American forest trees' seems extremely good, both from an educational and scientific standpoint. It comprises a branch, flowers, fruits and block of wood from one tree; a photograph of the same tree in summer and winter; a seven-foot section of the trunk, a transverse section; commercial planks and, finally, a map of North America colored to show the distribution of the species. The mammal groups of Mr. Akeley, who is unrivaled in this work, are deserving of special notice, particularly that of the Lesser Koodoo with its striking central figure. The group of Musk oxen contains, so far as we are aware, by far the best series contained in any museum.

Appleton's Popular Science Monthly for January contains an article on the 'Causes and Distribution of Infectious Diseases,' by Surgeon-General George M. Sternberg. The subject is treated historically, and includes a brief outline of the more serious epidemics of the past one hundred years.

WE quote the following editorial note from the December issue of the London *Educational Times:* "Eulogistic notices of the late J. J. Sylvester, Savilian professor at Oxford, whom our readers will remember as a frequent contributor to our columns, have appeared in the mathematical and other journals of America, France, Germany and Belgium. Professor Halsted, writing in SCIENCE (U. S. A.), says: 'When one thinks that Sylvester, William Thomson, Maxwell, Clifford, J. J. Thomson, have all been second wranglers, one asks involuntarily if any senior wranglers, Cayley excepted, have been put on the same parallel with them?' Professor Halsted might have added Whewell and Glaisher to his seconds. But, as to the seniors, what about Paley (to match Whewell), Wollaston, the double seniors Kaye and Alderson, Herschel, Sir George Airy, Main, Stokes, Adams, Todhunter, Tait, Lord Rayleigh, and Cayley aforesaid? However, it must be admitted that there are some heavy weights in the other scale." There is nothing in any American college or university corresponding to the extreme specialization of the mathematical Tripos at Cambridge. Yet a method which secures such extraordinary results should at least be carefully studied.

To the numerous 'Années' recently established in France will now be added *L'Année sociologique*, edited by M. Durkheim, professor of sociology at Bordeaux, and published by M. Felix Alcan, Paris. The volume for 1897 will be issued early next year and will contain original articles by the editor and by Professor Simmel, of Berlin, followed by systematic reviews of the literature. We regret that the attempt will not be made to give a complete bibliography, but perhaps this will be added to later volumes.

THE *Western Medical and Surgical Gazette*, which has just begun publication at Denver, under the charge of professors in the Gross Medical College is, we believe, the two hundred and twenty-sixth monthly medical journal now being published in the United States. This would allow one monthly journal for each 500 physicians in the country, and probably not one-half of them subscribe for any journal. It is not necessary to predict whether mediocrity or progress through survival of the fit will result. It is, however, but fair to state that the new *Gazette* promises better than many of the medical journals that we receive.

PROFESSOR G. SERGI, of the University of

Rome, expounds in the January *Monist* his theory of the origin of Latin and Greek civilization, which he claims was not the creation of the Aryans, who were an inferior stock, but of the Mediterranean race proper; the Aryans merely transformed the *language* of the Mediterranean races. In the same number Major Powell traces 'The Evolution of Religion' in the light of ethnology and the general history of civilization; Dr. Woods Hutchinson holds an impassioned brief for 'Love as a Factor in Evolution,' wherein he shows that love, sympathy, charity, etc., which are generally supposed to be subversive of natural selection in society, are really the prime conditions of evolutionary progress, through their strengthening of the moral fibre and their enhancing of solidarity. The philosophical articles are: (1) 'Causation, Physical and Metaphysical,' by C. Lloyd Morgan; (2) 'The Philosophy of Laughing,' by Dr. Paul Carus; (3) 'On the Philosophical Basis of Christianity in Its Relation to Buddhism,' by Professor Rudolf Eucken. As for the first of these, Professor Morgan seeks the solution of the problem of causation in the separation of the domain of knowledge into two provinces, a physical province and a metaphysical province. The search for transcendental causation in the latter province is as legitimate in its way as the search for scientific causation in the former province. The book reviews of the number embrace philosophy, psychology, biology and comparative religion.

TEN or twelve years ago *The Critic* published a series of 'Authors at Home,' including sketches of Lowell, Whittier, Holmes and other American men of letters. In its issue for the 18th ult. *The Critic* begins a new series of 'Authors at Home,' with a sketch of 'Charles Conrad Abbott, M.D., at Trenton,' by Mr. Ernest Ingersoll, who holds that 'systematists and dissectors' have not appreciated Dr. Abbott's contribution to science, owing to 'its literary form.'

The Contemporary Review.—Why can we not have in America monthly reviews as good as *The Contemporary*, *The Fortnightly* and *The Nineteenth Century?* — for December contains several articles of scientific interest. A well-informed writer who signs himself 'A British Naturalist' discusses the seal question from an American point of view. The article concludes with the paragraph: "Hence, considering that the industry is commercially of no great importance, that the pelagic sealing involves the killing of pregnant females and the starving of their pups, and that the United States can settle the question over the heads of England and Canada, it seems a pity that the argument should be embittered by abuse of the United States. The question has been so simplified that the officials on both sides no doubt see the advisability of a friendly settlement. And it is to be hoped that the British press will give that fair open-minded consideration to the American claims that has marked the irreproachable attitude of the British Foreign Office."

ANOTHER article in the current number of *The Contemporary Review* is a criticism, by Mr. Andrew Lang, of the recently published work on 'The Evolution of the Idea of God,' by Mr. Grant Allen. Mr. Lang maintains, and not without reason, that Mr. Allen's treatment is not strictly scientific in character, but Mr. Lang himself holds that savages got their idea of spirits from converse with real spirits. Whence the conclusion is not unnatural that literature, science and writing for the market do not combine to produce results of value to science.

AT a recent meeting of the Royal Botanical Society, of London, Mr. Sowerby, the Secretary, called attention, as reported in the London *Times*, to some kola plants grown in the gardens, and said that the tree, which was a native of the west coast of Africa between Sierra Leone and the Congo, belonged to the natural order Stericuliacæ. The seeds, several of which were contained in a fleshy fruit, 4 inches to 6 inches long, were the well-known kola nuts of West Africa, where they had been used as far back as it was possible to trace. By eating these seeds people were enabled to endure prolonged labor and exertion without fatigue. It was estimated that kola paste is five times more sustaining than cocoa; it contained over 2 per cent. of pure caffeine, and, compared with tea, coffee and cocoa, the kola preparations were

far more nutritious and did not create biliousness, as did cocoa and coffee, nor nervous excitability, as in the case of tea, so that the problem of "What may we drink?" might probably be solved. A number of these plants were propagated at Kew in 1880 and distributed to Calcutta, Ceylon, Zanzibar, Demerara, Dominica, Sydney, Mauritius, Java, Singapore and Toronto, where the nuts were now produced. It had been reported from Jamaica that if a demand should arise for them the nuts could be shipped to the extent of many tons per year. Notwithstanding its important properties, it is only lately that any great demand has arisen for the production. As a medical agent it is specially valuable as a powerful nerve stimulant. The kola nuts may supply a valuable medicine to the pharmacopœia, as Mr. Sowerby states, but it is doubtful whether the Kew Gardens have done a philanthropic work in extending its use. It is already sold in large quantities, both in Great Britain and America, and while it may itself be no more harmful than coffee, when mixed with from 10 to 25 per cent. of alcohol, as is usually the case, it becomes a powerful and dangerous intoxicant. The fact that it is sold at apothecaries, often to women and children, rather than in saloons does not decrease the harm that it does.

UNIVERSITY AND EDUCATIONAL NEWS.

IN amplification of the note published last week in this JOURNAL regarding the gifts of Mr. W. C. McDonald to McGill University, Montreal, we are informed that the endowment consists in the foundation of an additional chair of chemistry. It will be remembered that Mr. McDonald recently erected a new chemical building at a cost of $240,000. Mr. McDonald has further now given an additional endowment of fifty thousand dollars for the Faculty of Law, to the Deanship of which Faculty, with the chair of Roman Law, Mr. E. P. Walton, of the Scotch bar, was recently appointed. Mr. McDonald has, moreover, supplemented the existing endowments associated with his name by a further gift of $200,000, to provide for any deficiency in income that may result from the fall in the rate of interest on investments.

THE sum of $45,000 has now been collected for a Science Hall for Syracuse University. It is expected that the erection of the building will be begun in the spring.

MRS. GEORGE SMELTZ, of Hampton, Va., has given $5,000 to Richmond College, to be used in the erection of a science building.

A NEW building for the biological laboratory was begun at Adelbert College in October, and will probably be completed in September, 1898. The building is of Gothic design and is to be built of stone, three stories high and basement. The outside dimensions are about 93 by 63 feet. The estimated cost with equipment is $43,000.

WITH the October Convocation the University of Chicago closed its first period of five years of graduate work, during which it conferred the degree of Doctor of Philosophy on seventy-seven candidates, distributed among the several departments as follows: Zoology, 12; Chemistry, 6; History, 6; English, 6; Sociology, 5; Semitic, 5; Political Economy, 4; Germanic, 4; Greek, 3; Romance, 3; Geology, 3; Physiology, 3; Mathematics, 2; Indo-European Comparative Philology, 2; Physics, 2; Anthropology, 2; Philosophy, 1; Botany, 1; Biblical and Patristic Greek, 1; Political Science, 1; Paleontology, 1; Comparative Religion, 1; Old Testament Literature, 1; Systematic Theology, 1; Church History, 1; not represented, Anatomy, Archæology, Astronomy, Latin and Neurology. The student of science may fairly ask whether, when twelve doctorates are conferred in zoology and but three in Latin and Greek combined, this means that there is less demand for teachers of the classics or that a less exacting preparation is required.

WE quoted in a recent issue the statement of the principal of the 'late' Evelyn College to the effect that the College had been closed because Princeton University refused to recognize its work for the higher education of women. A correspondent fully acquainted with the facts writes us: "Evelyn College was closed on account of bad debts, and in the opinion of its own board of trustees should have been closed some time ago. So far from giving the institution the cold shoulder the University authorities allowed

their names and the University name to be freely used. Various professors expended much time and effort on their courses in Evelyn, and continued to do so, though generally failing to receive the small stipend which was promised them. Certain University officers, both faculty and trustees, served on the Evelyn board, but resigned because they could not approve of the way the institution was financially managed. Seeing that Evelyn College was closed only after the patience of everybody in Princeton, from tradesmen to trustees, was tried to the utmost, and the courtesies of the authorities strained to the breaking point, it is necessary that such a misstatement of the facts should be corrected." These facts do not apparently relieve Princeton University from the responsibility of being the only considerable university in the world that does not provide in any way for the higher education of women.

DISCUSSION AND CORRESPONDENCE.

BEHRING SEA CONFERENCES.

To the Editor of Science: I have read with great interest the article on the results of the Behring Sea conferences, published in your number of November 26th (Science, N. S., Vol. VI., p. 781), which puts forward what is, I believe, the view of the 'seal question' held by most naturalists in every country in a clear and temperate manner. I venture to point out to you that more than four years ago I endeavored to place the question in a somewhat similar light before the British public in an article entitled 'A Naturalist's View of the Fur-Seal Question,' published in *The Nineteenth Century* for June, 1893, Vol. XXXIII., p. 1038). I beg leave to add an extract from this article in order to show the conclusions to which I had then arrived: "The absolute prohibition of 'pelagic' sealing which is demanded by the Americans, and which out to be carried out in order to ensure the continued existence of the fur-seals, can only be obtained by mutual arrangement among the parties interested. The fur-seal of Alaska (practically now the only remaining members of the group of fur-seals) should be declared to be, to all intents and purposes, a domestic animal, and its capture absolutely prohibited except in its home on the Pribilof Islands. Looking to the great value of the privilege thus obtained, America might well consent to pay to Great Britain and her colonists some compensation for the loss of the right of 'pelagic' sealing; the amount of this compensation would be fairly based upon the number of fur-seals annually killed upon the Pribilof Islands. The 'royalty' thus levied would no doubt increase the price of seal-skin jackets. But seal-skin jackets are not a necessary luxury, and an additional pound added to their cost would not be of material consequence to the ladies who wear them. As a naturalist, therefore, I think that the fur-seal should be considered in the light of a domestic animal, and that all 'pelagic' sealing should be stopped, while the owners of the sealeries should at the same time pay to the other nations interested a reasonable compensation for the valuable privileges thus obtained."

P. L. Sclater.

3, Hanover Square, London, W.
December 15, 1897.

THE ENCHANTED MESA.

To the Editor of Science: Referring to your postscript to my letter written in response to a communication to Science by Professor Libbey, I take the liberty of saying that, as the gentleman mentioned has *not* stated positively that *he* erected the stone monument on the summit of the Enchanted Mesa, one must reach such a conclusion only by inference. My reasons for not accepting anything short of a statement couched in unmistakable terms are based on what Professor Libbey has already contributed to the literature of the Enchanted Mesa. In the first place (*Princeton Press*, July 31) he says:

"No traces of former inhabitants were found. Further, no altars or traces of prayer sticks were found. * * * Not the slightest trace was found which would enable me to believe that a human foot had *ever before passed* over the top of this famous rock."

Again (*Princeton Press*, August 21) he says:

"For two hours I walked over the surface of the rock. * * * It is a splendid site for a pueblo, if some means of access could be de-

vised, but it could not have been freer of all traces of former occupation if it had been thoroughly swept up the day before. Only once was it that a doubt crossed my mind, when I came across a cairnlike monument which looked as though it might have been constructed by human hands. But the possibility of its being the result of erosion is also quite as strong as the other. No bits of pottery, no broken household utensils of any sort, no traces of construction of any sort were visible, not even the deepening of the natural surface of any of the rock cavities for the purpose of rain-water storage for drinking use, betrayed even the slightest indication that the top of the Mesa had ever been the prehistoric home of the Acomas.''

In *Harper's Weekly* (August 28) Professor Libbey makes the following statement:

'' There were no remnants of pottery, or fragments of household utensils, or implements of any kind; no water-tanks for the storage of rain water; one object alone looked as though it might have been built by human hands, and that was a small cairnlike mass of stones.''

In this article Professor Libbey pictures the operation of his gun, boatswain's chair, etc.; but where is the 'cairnlike mass of stones' which he found, the origin of which he seems to be at such a loss to determine? It seems to me that this doubtful feature is the most important of all the observations made by Professor Libbey during his brief stay on the summit, and yet he left it unphotographed.

Later, in the *Philadelphia Press* (October 10), Professor Libbey says:

'' The cairn-like pile of rocks, which I am glad Mr. Hodge so clearly decides is a cairn, is possibly the best proof of a mere visit, for even primitive people are not given to building cairns in their back yards. * * * *

''I am inclined from the facts which I was able to observe upon the top of the Mesa *still* (*!*) to believe that while the top may have been visited, no evidence exists at present of its ever having been permanently inhabited.

''I picked up some fragments which resembled ancient pottery, but could not persuade myself that they were. I took them to Mr. Pearce [one of the reporters who accompanied Professor Libbey], and he agreed with me that they were not pottery.''

The fact that the Professor fails to speak of having occupied part of his precious two hours in the erection of the lichen-covered rock-pile which we found and photographed, and the fact also that the structure occurs on a spot so protected from the surface wash that it may have stood there for ages, were sufficient to mislead anyone, and my error may be regarded as acknowledged when Professor Libbey states openly that the monument was erected by himself.

The better part of two days of research by the members of my party, each of whom had his eyes open, failed to reveal any other artificial monument than the one which I have figured. I am, therefore, safe in concluding that there is no ground whatever for the belief that any other artificial cairn or cairn-like structure exists on the summit of the Enchanted Mesa. If Professor Libbey constructed the cairn referred to, then he might have spent the portion of the two hours consumed by its erection in a way more profitable to archæology. Whether or not it was erected by him, the evidence of the former occupancy of the summit of the Enchanted Mesa is not weakened in the slightest degree.

F. W. HODGE.

BUREAU OF AMERICAN ETHNOLOGY,
WASHINGTON, December 14, 1897.

LAMARCK AND THE 'PERFECTING TENDENCY.'

IN preparing some lectures on the history of evolution theories I have come across a curious difference of opinion among distinguished writers. Professor Osborn ('From the Greeks to Darwin,' p. 163) seems to contradict himself in the same paragraph. He says: ''Lamarck believes that we see in nature a certain natural order imposed by its Author, which is manifested in the successive development of life; we thus study natural forces and nature abandoned to its laws. In this sense we see nature creating and developing without cessation towards higher and higher types. External conditions do not alter this order of development, but give it infinite variety by directing the scale of being into an infinite number of branches.''

This statement might, without violence, be paraphrased by saying: "Lamarck believed in a tendency toward perfection, modified by external conditions;" which I believe to be strictly correct. But Professor Osborn's next sentence is: "Lamarck denied, absolutely, the existence of any 'perfecting tendency' in nature, and regarded evolution as the final necessary effect of surrounding conditions on life."

On looking up other writers I found that a belief in a perfecting tendency is ascribed to Lamarck by Lyell (Principles, Vol. II., p. 259), Darwin (Origin, Amer. ed., I., pp. xv+153, and Life, I., p. 384), Spencer (Biology, Section 146), Romanes (Darwin and after Darwin, I., p. 255). Perrier (Phil. Zool. avant Darwin, p. 84) argues strongly on the same side. Strangely enough, Quatrefages (Darwin et ses Précurseurs Français, p. 65) takes quite the opposite view, and directly accuses Darwin of error. I have been unable to consult any of Lamarck's works except the Philosophie Zoologique, but so far as that is concerned the majority view seems to be the correct one. Throughout, though Lamarck does not exactly use the expression 'perfecting tendency,' he distinguishes between two things—one, the *échelle*, the *dégradation* or *gradation* of organisms, their tendency to *composition* (complication, advancement); the other, the influence of environment in altering their needs and thus their structure. The *échelle* is a pre-established order through which organisms have progressively evolved, but visible only in its grand outlines, because changing conditions have indirectly altered the form of the organisms, especially externally, and thus obscured the details.

A pre-established order of evolution from the lowest to the highest forms seems to amount to the same thing as a tendency towards perfection.

I have been unable to find any passages which can be construed as an absolute denial of a perfecting tendency, but I have found a good many which indicate that Lamarck believed in it; whether or not because he was unable to suggest anything better to account for the progressive evolution which he saw, who can say? The following are sufficiently good examples:

"La puissance absolue du sublime Auteur de toutes choses, n'a-t-elle pu créer un *ordre de choses* qui donnât successivement l'existence à tout ce que nous voyons comme à tout ce qui existe et que nous ne connaissons pas?" (Phil. Zool. ed. 1873, I. p. 74.)

"Je vais faire voir que la nature en donnant, a l'aide de beaucoup de temps, l'existence à tous les animaux et à tous les végétaux, a réellement formé dans chacun de ces régnes une véritable échelle, rélativement à la composition croissante de l'organisation de ces étres vivants, mais que cette échelle, qu'il s'agit de reconnaître, en rapprochant les objets, d'après leurs-rapports naturels, n'offre des degrès saisissables que dans les masses principales de la série générale, et non dans les espéces ni même dans les genres: la raison de cette particularité vient de ce que l'extrême diversité des circonstances dans lesquelles se trouvent les différentes races d'animaux et de végétaux n'est point en rapport avec la composition croissante de l'organisation parmi eux, ce que je ferai voir, et qu'elle fait naître dans les formes et les caractères extérieurs des anomalies ou des espèces d'écarts que la composition croissante de l'organisation n'aurait pu seule occasionner." (l. c., p. 121.)

On page 144 Lamarck says: "Il est évident que si la nature n'eut donné l'existence qu'à des animaux aquatiques, et que ces animaux eussent tous et toujours vécu dans le même climat, la même sorte d'eau, la même profondeur, etc., sans doute alors on eût trouvé dans l'organisation de ces animaux une gradation régulière et même nuancée." And then he shows that differences in the composition, depth, etc., of the water have brought about disturbances in the regularity of the gradation. Lamarck invariably uses *gradation* in the sense of an upward series, opposing it to *dégradation*, a downward series.

A very important passage is that quoted by Perrier from Phil. Zool., p. 114. Lamarck states the struggle for existence according to his imperfect conception of it, showing how big and little animals alike are kept within due bounds. He concludes: "Ainsi par ces sages précautions tout se conserve dans l'ordre établi; les changements et les renouvellements perpétuels qui

s'observent dans cet ordre sont maintenus dans des bornes qu'ils ne sauraient dépasser; les races des corps vivants subsistent toutes, malgré leurs variations; les progrès acquis dans le *perfectionnement* de l'organisation ne se perdent point; tout ce qui paraît désordre, renversement, anomalie, rentre sans cesse dans l'ordre général et même y concourt; et partout et toujours la volonté du sublime Auteur de la nature et de tout ce qui existe est invariablement exécutée." Lamarck rather rarely uses the word *perfectionnement*; hence I have italicized it.

The passage concerning the aquatic animals very clearly shows a belief in a tendency toward perfection apart from other factors. The other passages, especially the last, are fully confirmatory.

I have been unable to consult the Histoire Naturelle, except as quoted by Professor Osborn and others. Possibly it is there that Professor Osborn finds authority for the statement that Lamarck denied absolutely the existence of a perfecting tendency. But so far as the Philosophie Zoologique is concerned the case is clear.

The point I have raised is important now only as a matter of history, but in the interest of accuracy it seems desirable that Lamarck's true views should be emphasized. It would appear that he was not 'completely carried away with the belief that his theory of the transmission of acquired characters was adequate to explain all the phenomena' (Osborn l. c., p. 180); rather, the 'Lamarckian factor' played a subordinate part in his scheme of evolution. And, if this interpretation be correct, it would seem that Darwin's criticisms of Lamarck are more nearly just than is generally supposed, and that, as Perrier says, he was, 'by an astonishing contradiction, at once a finalist in his general views, and a determined opponent of final causes in details.'

JOHN GARDINER.

UNIVERSITY OF COLORADO, BOULDER, COLO.

MEMORIAL MEETING COMMEMORATIVE OF ALLEN AND HORN.

A GENERAL invitation is extended to all those interested to be present at a memorial meeting, commemorative of Harrison Allen, M.D., and George H. Horn, M.D., to be held in the library hall of the Academy of Natural Sciences of Philadelphia, on Friday evening, December 31st, at eight o'clock. The following gentlemen will make addresses:

Dr. Edw. J. Nolan, 'The Relations of Doctors Allen and Horn to the Academy and other Societies.'

Mr. S. N. Rhoads, 'Dr. Allen's Work in Zoology.'

Dr. D. G. Brinton, 'Dr. Allen's Contributions to Anthropology.'

Professor John B. Smith, Sc.D., 'Dr. Horn's Contributions to Coleopterology.'

Rev. Henry C. McCook, D.D., 'Dr. Horn as a Physician and Naturalist.'

E. G. CONKLIN, PH.D.,
J. CHESTON MORRIS, M.D.,
D. G. BRINTON, M.D.,
REV. HENRY C. MCCOOK, D.D.,
HENRY SKINNER, M.D., *Ch'm.*
Committee.

THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA,
LOGAN SQUARE.

SCIENTIFIC LITERATURE.

Memorials of William Cranch Bond, Director of the Harvard College Observatory 1840–1859, and of his son, George Phillips Bond, Director of the Harvard College Observatory 1859–1865. EDWARD S. HOLDEN. San Francisco. 1897. Pp. iii+296. 8oc. With illustrations.

In this work Professor Holden has given a most interesting account of the two men who established the Observatory of Harvard College and carried it on for its first quarter of a century—a time of great importance for the development of astronomy in this country.

In 1840 the beginnings of permanent observatories in this country had already been made; in 1865 the Observatory at Cambridge had acquired, under the Bonds, a recognized position in the astronomical world, and the Bonds had contributed to the general progress of the science.

Professor Holden's work has been rendered important, and at the same time difficult and thankless, by circumstances which he finds

himself compelled to mention. It cannot be called a history of American astronomy for the quarter of a century in question, but Professor Holden has furnished, with the help of the family of the Bonds, a valuable contribution thereto.

The most troublesome part of the author's task has been to rightly explain the long and persistent unfriendliness of prominent American astronomers to the new institution and its conductors. W. C. Bond was one of those quiet artists who so often do admirable service to the science in an unpretending way without making claim to the position of a great theoretical astronomer.

The first difficult task for Professor Holden has been to give the history of chronographic registration and the part of the Bonds in the invention.

Wilkes in 1844 (p. 239) made the first experiment for determining longitude by the electric telegraph between Washington and Baltimore. Sears C. Walker, a most able astronomer, gives in *Silliman's Journal*, Second Series, Vol. VII., pages 206 to 217, a report to Dr. A. D. Bache, then Superintendent of the Coast Survey, in which the history of the first experiments in chronographic registration is well told. Professor Holden mentions the subsequent experiments of 1847 and 1848 to render the telegraphic method thoroughly practicable for longitude determinations.

In Loomis's 'Recent Progress of Astronomy' (New York, 1850) we find the actual results of the longitude operations of the summer of 1847 conducted between Philadelphia, Washington and Jersey City, from which Loomis draws the inference: "These experiments seem to authorize the conclusion that the electric telegraph affords the best means for the determination of terrestrial longitude between places in telegraphic connection with each other." This inference of Loomis has been confirmed by subsequent experience.

Walker, in his article before cited, mentions the experiments of Locke, Mitchell and others, and dwells greatly on the merit of the proposed 'automatic clock register,' and of the principle of chronographic registration for all time-observations.

Locke's part in the experiment seems to have been to arrange, under Walker's direction, apparatus for making and breaking circuit without damage to the clock. Mitchel, on the other hand, suggested a form of chronograph not suitable in Walker's opinion for nice astronomical observations.

The apparatuses of both Locke and Mitchel were tried in 1848 under Walker's direction. On the whole, Professor Holden has well stated the history; some points are obscure in all the accounts, and it requires a careful reading and putting together of the literature of the subject to rightly assign priority in the different parts of the invention, in which howsoever we combine the materials; the principal figures are Walker and W. C. Bond, and the subordinate ones are Locke and Mitchel.

Bond's chronograph was exhibited at the Great Exposition of 1851 in London, and distinguished with a gold medal. These circumstances seem to have led to the introduction of chronographic registration at Greenwich in 1854. Thence it spread rather slowly over the Continent; it was adopted for standard right ascension at Pulkova in 1861, but the eye and ear method was still retained there for polar stars and secondary catalogues, in which it has some advantages, especially in respect of personal equations. In America the chronographic method has been used quite generally, and the Bond chronograph has become a standard instrument. It has been used at the Harvard College Observatory from its first construction in 1850 to the present time. It served for the zone 50°–55° of the catalogue of the Astronomische Gesellschaft, as well as for the Bonds' own zones of small stars observed in 1852–53, and other work executed during their successive directorships and later.

Other difficult matters of the history of the Observatory are stated by Professor Holden with due regard for the feelings of the representatives of the astronomers of the last generation. The Perkins professor of astronomy when W. C. Bond removed to Cambridge in 1838 and began the duties of his office was Benjamin Peirce, one of the most eminent mathematical astronomers of his day. It is rather difficult, as Professor Holden im-

plies on pages 36 and 37, to understand the whole matter, without alluding to 'grievances half a century old.' W. C. Bond became, in 1838, 'astronomical observer' without salary except the rent of a dwelling house, and without definite relations to the younger 'Perkins professor.' Peirce, perhaps, expected rather too early from the new establishment results which could be 'passed over to the computer.' G. P. Bond, B. A. (Harvard), 1845, was a diligent student of astronomy in all its branches, and soon showed himself capable of improving the methods of computation, as is shown by his early papers, especially 'Some Applications of the Method of Mechanical Quadratures'—a paper which anticipated an important method of Encke's, and which affords ideas not yet completely worked out. One of the few papers which he contributed to the *Astronomical Journal* is entitled 'On the Orbit of Wilmot's Comet,' and employs methods of his own which deserve study.

When W. C. Bond passed away in 1859, at the age of 70, his son had long been the chief assistant in the Observatory, and succeeded quite naturally to his father's place, but Peirce had been himself a candidate, and circumstances had brought about an estrangement between him and Bond, but the latter seems to have done his best to renew pleasant relations.

Other matters, easily traced, are involved in the reasons why these relations were not renewed. Professor Holden alludes to the circumstance that George Bond was not selected as an original member of the National Academy of Sciences as a matter requiring explanation. But this concerns the history of American science in general, and not merely the few persons who may have made up the list submitted to Congress. It is not best to imply here that the omission was more unfair than similar transactions are often liable to be.

At the time, 1863, when the National Academy was founded, Bond had been four years Director of Harvard College Observatory, and had shown in that capacity ample knowledge of mathematics and astronomy to fill the position completely. He had gathered around him a corps of hard working assistants, among them Asaph Hall. The meagre salaries which the College could pay were rendered still more inadequate by the war then prevailing, and the corps of astronomers was diminished by the call for soldiers. One able and enthusiastic observer, Sidney Coolidge, fell in the battle of Chickamauga. The remainder of the assistants were compelled, with one exception, to seek occupation elsewhere. Bond himself struggled on heroically, although stricken with a mortal disease, and finally passed away at his post in 1865, before the close of the war, after completing the great work on Donati's Comet of 1858, the first work of an American astronomer to be rewarded with the gold medal of the Royal Astronomical Society. The vindication of the wisdom of his appointment as Director was complete, but he never received the medal which reached America a short time after his death.

Professor Holden's book has been put together from G. P. Bond's diaries and correspondence, and with the zealous cooperation of his family, Mrs. Richard Bond and his daughters. The author's work is, on the whole, well and judiciously done; some trifling defects are apparently due to unfavorable circumstances; such, for instance, are the want of a subject index; the Index of Proper Names is very defective; the spelling of German names like Brünnow and Rümker is not correct, and the use of capitals to indicate names of persons is a technical practice not approved in general literature. While the book is not a complete history of astronomy in America from 1840 to 1865, it affords precious materials for such a history, and should be read by all who desire to follow out that period of our science, and at the same time to become acquainted with two of its most prominent and faithful workers in the traditional as well as in the newer astronomy. G. P. Bond's experiments in astronomical photography were of very great importance and, in fact, were prior even to Rutherfurd's.

TRUMAN HENRY SAFFORD.

WILLIAMS COLLEGE.

Handbuch der Klimatologie. Von DR. JULIUS HANN. Stuttgart, Germany, J. Engelhorn. 1897. Second edition. 3 vols. 36 Marks.

If I were asked to mention the greatest authority on matters pertaining to climate and

climatology I should give, without hesitancy, the name of Dr. Julius Hann, the director of the Austrian meteorological service.

In 1883 Dr. Hann published a long needed book, a general treatise on the climatology of the whole earth's surface. This work was the outcome of many years of special study and research, and required several years of direct labor in its actual writing. It was received with enthusiasm by the German reading scientific public, and English readers deplored the fact that we had no corresponding work in English. Fourteen years have now elapsed since Hann's work first appeared, and its second and greatly enlarged and rewritten edition finds our language still without any general work on climatology. We have not even a translation to fill the place which should be occupied by a work of honest English or American authorship, and it is to be hoped that some publisher will be induced to take advantage of the appearance of this new German work by bringing out a translation of it either in full or in abridgment.

Hann's climatology consists of three volumes. The first is devoted to general climatological conditions, in which the relations of cause and effect are discussed for the various meteorological elements. The second volume is devoted to the special climatology of the regions embraced in the tropical zone. The third volume treats of the climate of the temperate and cold zones.

One serious drawback to the usefulness of the work is the lack of climatological charts; but the author explains that they were omitted because they would considerably increase the price that must be asked of purchasers of the present treatise, and, moreover, such charts had been published elsewhere in easily accessible form.

The 404 pages of Vol. I. contain: A general idea of the scope of climatology; and complete explanations of the nature, importance and relation to each other of the climatic factors, temperature, humidity, precipitation, cloudiness, wind, air pressure and evaporation. A short statement of the composition of the air and the impurities which it may contain, together with some remarks on plant phenology as related to, and dependent on, climatic conditions. A brief though comprehensive review of our knowledge of the amount of radiation from the sun and the resulting 'solar climate.' The principal forms of telluric or physical climate, which is the solar climate modified by the earth's atmosphere and the existing distribution of land and water; this naturally occupies the greater portion of Vol. I. And, finally, the meteorological cycles and climatic oscillations.

Let us notice more particularly some of the most interesting facts given by the author.

Owing to the elliptic form of the earth's orbit, by which the earth is sometimes a little nearer the sun than at other times, the southern hemisphere receives more solar heat in summer and less in winter than the northern hemisphere. If our earth had no atmosphere the average temperature at the earth's surface would be, *at the equator* for the hottest month 67°C. and for the coldest month 56°C., and *at the poles* for the hottest month 82°C. and for the coldest month —273C. (which latter is, curiously enough, the absolute zero of the thermometric scale).

Concerning the interesting question of the effects of forests on rainfall Hann says that from the nature of the case it is almost impossible to prove anything by direct measurements, and that the increase of rainfall due to forest growth has been far over-estimated. It is quite probable, however, that in the tropics the woods do slightly increase the amount of precipitation, and extensive woods in the middle and higher latitudes probably increase the frequency of rainfall.

The effects of mountains on rainfall has received thorough treatment at the hands of the author, and especially that peculiar phase of increase of rainfall with the altitude up to a certain level, and the subsequent gradual decrease at greater heights. With an increase of altitude amounting to from 2,000 to 4,000 feet the rainfall may be increased by from 50 to 250 per cent. This increase of rainfall is due to the condensation of the moisture in ascending air currents which form on mountain sides.

It has been computed, retrospectively, that in Jurassic times the mean temperature of the earth was about 2°C. warmer than it is at pres-

ent. At about Lat. 30° N. it was colder, but in other latitudes warmer, and at the equator about 6.5°C. warmer then than now.

The decrease of air temperature with the increase of altitude above the sea-level is of very great importance in climatological considerations, and Hann has given a careful discussion of this phenomenon.

The average decrease of temperature in mountain regions is 0.57°C. per 100 meters ascent, and it seems to be quite uniform for both equatorial and arctic regions. For the very gradual ascents, such as long slopes, the temperature decrease is but about 0.40°C. per 100 meters ascent; while for the free air it is probably about 0.65°C. These values show considerable retardation of the dynamic change of temperature, which is about 1°C. per 100 meters ascent.

Among the peculiar winds none are more interesting than the hot, dry winds which occur in certain mountain regions, and which in Europe are known as Foehn winds, and in the United States as Chinook winds. It was to have been expected that Dr. Hann would devote considerable space to these winds, because they are with him a pet subject; although his modesty has caused him to place his first contribution to its literature a long way down in the reference list, whereas it should have headed that bibliography. Probably no single class of winds have been so little understood as these Foehn winds; and after searching in all directions for some reason for their existence, the simple theory that they are due to the dynamic heating of descending air masses which have a decreased relative humidity due to the increased temperature has sufficed to explain what was considered a most complex phenomenon.

One very interesting problem in climatology is, to determine how the different elements, such as temperature, rainfall and cloudiness, vary with changes of latitude. This is shown by finding the average values of the elements for certain parallels of latitude throughout their whole length as they encircle the globe.

The following little table gives for various latitudes the average temperature for the whole year in degrees Fahrenheit; the average total annual depth of precipitation (which includes both rainfall and snowfall) in inches; and the average annual amount of cloudiness measured on a scale of 0 = a clear sky, and 100 = a sky entirely overcast with clouds.

Lat.	Temp.	Precip. inch.	Cloud per cent.
N. 80°	2°	14	—
70	14°	14	59
60	30°	19	61
50	42°	23	58
40	57°	21	49
30	68°	24	42
20	77°	32	40
N. 10	80°	76	50
Equator	79°	77	58
S. 10°	78°	67	57
20	74°	30	48
30	65°	26	46
40	54°	37	56
50	42°	46	66
S. 60°	31°	[40]	75

This table is also interesting from the fact that it indicates that we have meteorological observations 20° nearer the pole in the northern hemisphere than in the southern hemisphere.

The last section of this volume, which treats of climatic changes, may be divided into two parts —that treating of changes in geologic times, and that of changes shown by the records of modern civilization. This last has already been given to readers of meteorological literature in Brückner's *Klimaschwankungen*, and this same authority is freely quoted by Hann. But the outline of the various theories accounting for climatic changes in the distant past is a much needed summary. Hann states briefly the main theories which have been promulgated and which depend on possible changes in the inclination of the ecliptic, or in the eccentricity of the earth's orbit. A rough computation convinces him that the effects of neither of these would account for the changes which must have taken place in the earth's climate. Croll's theory is given due prominence, but Hann finds it unsatisfactory. A theory developed by Luigi de Marchi makes a variation in the coefficient of transmission of solar radiation through our atmosphere the important factor in these great climatic changes; but no certain causes of increase or decrease in the amounts of water vapor or carbonic acid gas, which would mainly affect the values of this coefficient, have been pointed out as appli-

cable to the existing case without any manner of doubt. The mystery of the great ice age, and of the former rich vegetation in the present cold zone, still remains to be solved.

FRANK WALDO.

An Outline of the Theory of Solutions, and Its Results, for Chemists and Electricians. By J. LIVINGSTON R. MORGAN, PH.D. (Leipzig), Instructor in Quantitative Analysis, Polytechnic Institute, Brooklyn. New York, John Wiley & Sons; London, Chapman & Hall. 1897. Pp. 63.

The contents of this work are four lectures, delivered before the Brooklyn Institute of Arts and Sciences, and deal with the theory of solutions, methods for the determination of electrolytic dissociation, the theory of the voltaic cell, and analytical chemistry from the standpoint of electrolytic disociation.

The author states in his preface that "a knowledge of the theory of solution and its results, is so important to workers in all branches of chemistry and electricity, that the following pages have been compiled, containing an elementary treatment of the subject." * * * "If by this sketch the author can induce any one to go deeper into the subject he will feel more than repaid for his work."

H. C. J.

Untersuchungen über das Erfrieren der Pflanzen. MOLISCH. Jena, Gustav Fischer. 1897. Pp. viii + 73. 11 illustrations.

A notable addition to the physiology of the cell has been recently published by Professor Molisch as a result of several years' work upon the effect of cold upon plants.

The researches upon which generalizations rest are fragmentary and necessarily inaccurate, since they were carried on in the open air or under conditions of great discomfort to the observer. At the same time no regulation of the temperature could be effected. Dr. Molisch has been enabled to obtain results of great importance, both from the advance in cell physics since the time of Muller's experiments and by the use of ingeniously constructed apparatus.

Dr. Molisch's researches were chiefly conducted by means of a double-walled freezing chamber of wood 33 x 33 x 27 cm. outside measurements. The space of 7 cm. between the double walls on five sides of the chamber was filled with sawdust. The center of the chamber was occupied by a zinc compartment to contain a microscope. A tubulated opening through the walls of the zinc and wooden compartments allowed access of light to the mirror, and toothed rods for adjustment of the stage, objectives and mirror extended outside the walls. The space surrounding the zinc compartment was filled with a mixture of salt and ice, by which temperatures of 4°C. to 10°C. were obtained in a room kept at 10°C.

As a useful preliminary, observations were made upon the freezing of colloidal substances, emulsions, color and salt solutions. The crystals were seen to appear suddenly in a colloid, such as gelatine, and to increase in size, extracting the water from the gelatine, so that the latter shrunk into a network resembling parenchyma tissue. Some colloids return to the original condition upon thawing; others do not. Starch paste is an example of the latter. The suspended particles in an emulsion, such as latex, aggregate in the form of a network of bands upon freezing. Freezing of color and salt solutions result in the more or less complete separation of the solid and solvent.

The chief interest of the paper lies in the results of the direct and continuous observation of the freezing of living cells.

An amœba, after exposure of 25 minutes to a temperature of 9°C., exhibited the formation of clumps of ice crystals in the plasma, and finally became a solid lump consisting of a complicated network of plasma almost devoid of water, ice crystals, vacuoles of concentrated cell-sap and air-bubbles. The slender filaments of Phycomyces froze only when the temperature fell to —17° C. The small diameter of the cells seem to be a direct adaptation against freezing. Yeast cells exhibited a shrinkage of 10 per cent., due to loss of water when the medium was frozen, but the cells were not killed at –15°C. The freezing of Spirogyra filaments at –3 to –6°C. is accompanied by a shrinkage in diameter amounting to 62 per cent. and by the final aggregation of chlorophyll band and nucleus in the center of the cells. The excretion of water in this plant under low temperatures may be easily observed

if a specimen is mounted in olive oil. The excretion of water from the cells soon begins and a cylinder of ice is formed about the filament.

As a result of the work upon unicellular structures in many organisms, it is found that the freezing may be accompanied by the formation of ice in the cell, external to the cell membrane or in both places. In either case it is accompanied by a more or less complete separation of the water from the plasma. The exposure of tissues with strongly developed walls to low temperatures was accompanied by the excretion of ice into the intercellular spaces, followed by the formation of ice both here and in the cell. Not all the cells of a plant exhibit the same resistance to cold. A temperature of a few degrees below zero Centigrade may freeze a leaf while the guard cells and hairs will remain intact. These cells are likewise highly resistant to heat and other agencies, as Leitgeb has previously demonstrated.

The question as to the death of a plant upon freezing or consequent thawing has engaged the attention of a large number of workers. Molisch's results prove that generally the death of a plant is due to the direct action of cold upon the plasma, and that the consequent thawing does not matter whether slow or rapid, in air or water. To this generalization an exception is offered by the experience of Müller-Thurgau, who found that frozen fruits of the apple and pear were not destroyed if thawed slowly, a fact long known in household practice, and the experiment of Molisch with *Agave americana*, which behaved in a similar manner. These exceptions, of course, rest upon the provision that the temperature has not fallen below a certain limit.

The death of plants from temperatures above the freezing point may result from disturbances of the metabolic processes or the transpiratory activity. In the latter instance the 'frosting' of a plant is due to the decreased osmotic activity of the root hairs under low temperatures, and wilting of the leaves consequent upon an insufficient supply of water. Dr. Molisch is mistaken in attributing the origin of this idea to Krabbe, as the principle has been known for many years, although its detailed application was first exploited by Krabbe.

Among the plants which are killed by low temperatures above freezing point, the most delicately responsive are *Episcia discolor* Hook., *Sanchezia nobilis* Hook., *Eranthemum tricolor* Nichols., *E. couperi* Hook., *E. igneum* Linden., *Anœctochilus setaceous* Blume. The species in this list exhibit damage after exposure to temperatures 1.4° C. to 3.7° C. for periods of 18 to 100 hours. *Begonia stigmatosa*, *B. scandens*, *Bœhmeria argentea* Linden, *Tradescantia discolor*, *T. zebrina*, and *Euphorbia splendens*, *Ficus elastica*, *Gloxinia hybrida*, *Tropæolum majus*, are examples of a numerous class which are injured by longer exposure to the same temperature. It is to be seen that Molisch's carefully attained results sustain the contention of Goeppert and Müller-Thurgau that death from freezing is due to the formation of ice or to the direct influence of cold, and not to the processes of thawing as maintained by Sachs. The formation of ice entails the excretion of water from the protoplasm, and the great and rapid loss of the fluid results in the architectural disintegration of the plasma. The disintegration may be hastened by the poisonous action of concentrated cell-sap remaining.

So far as the results are at hand, it is to be said that the excretion of water by cells at low temperatures is not only a physical reaction, but this action has become under the direction of the protoplasm a protective adaptation. A second adaptation consists in the smallness of the cell.

D. T. MACDOUGALL.

SOCIETIES AND ACADEMIES.

BOSTON SOCIETY OF NATURAL HISTORY.

THE Society met December 1st; thirty-five persons present. Professor N. S. Shaler, in discussing Aeolian deposits in relation to the formation of river valleys, gave the result of his observations in Utah and Montana. Along the Ruby river, where the vegetation is dense and the soil rich, the loess is held and the valley built up. In Montana below 7,000 feet the vegetation is thin and insufficient to inhibit.

Mr. A. W. Grabau showed some fossils from the upper Devonian of western New York, and gave the views taken by various investigators as to the nature of Conodonts, since their discovery by Pander in the Silurian and Devonian

rocks of Russia. Mr. Grabau's studies confirm the position taken by Zittel and Rohon that these minute tooth-like fossils are the jaws of worms. He also discussed the relations of Styliolina, Cardiola and Clymenia, and the close parallelism between American and European Goniatites. Professor Hyatt took exception to Hinde's view, quoted by Mr. Grabau, as to the unity of the American and European forms; the late American faunas are residual; they do not originate types; the very ancient American faunas may be, however, originating faunas.

Dr. Jackson drew attention to the large numbers of associated fossils in very small space, and Mr. Grabau stated that Clark's investigations proved the identity of the American and European species.

SAMUEL HENSHAW,
Secretary.

THE TORREY BOTANICAL CLUB, NOVEMBER 9, 1897.

THE paper of the evening, by Mrs. E. G. Britton, a description of two new species of *Ophioglossum* will be printed in the *Bulletin.* The paper also discussed the affinities, range and type characters of our Eastern species of *Ophioglossum*, with keys and specific descriptions, and with exhibition of tracings and numerous mounted specimens.

Dr. Underwood sketched the characteristics of the four distinct types of *Ophioglossum* as: 1st, the section typified by *O. vulgatum* and discussed in the paper; 2d, that by *O. palmatum* of tropical America, which extends into Florida, there growing directly under the crown of the palmetto trees, nestled among the leaf-shrubs; 3d, that typified by *O. pendulum*, found in the Hawaiian Islands and Pacific regions, which is also pendulous from trees and produces a stipe attached almost to the middle of the leaf. In the 4th section, with growth not over one inch high, the sterile and fertile fronds are distinct to the rooting base.

Dr. Underwood further remarked the necessity of experience to discover forms of *Ophioglossum*, especially such as *O. crotallophoroides*, only one inch high, collected by him in Alabama.

Mr. Clute spoke of the great diversity in size displayed by *O. vulgatum* in a single locality.

Professor Burgess referred to the occasional occurrence of *O. vulgatum* with its own namesake *Pogonia ophioglossoides*, and to other companion-plants with which he finds *Ophioglossum* associated in growth, as *Chiogenes* and especially the orchids *Microstylis ophioglossoides*, *Habenaria hyperborea* and *H. dilatata.*

Dr. Underwood then exhibited photographs of the Kew Gardens, with reminiscences of his visit of last summer. He spoke particularly of their formal decoration, dating back to royal use, and the photographs shown included one of 'Queen Mary's Elm,' planted by her about 1555, once 25 feet in girth, now represented chiefly by a series of shoots.

EDWARD S. BURGESS,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis on December 20, 1897, twenty-five persons present, Dr. R. J. Terry exhibited several specimens of human humerus, showing supracondylar process associated with high division of the brachial artery, which was contrasted with similar processes that have been observed in the anthropoid apes and the lower monkeys, and with a similarly situated foramen of the arm of the *Felidæ.* It was stated that while a slight roughness was observed, at the point indicated, in a majority of ninety-six specimens observed, the structure was fairly developed in four out of this number, in all cases on the left arm.

Professor F. E. Nipher presented a paper describing a long series of experiments made to determine the distribution of pressure over a pressure board, and summarizing the results reached.

WILLIAM TRELEASE,
Recording Secretary.

NEW BOOKS.

A Genealogy of Morals. FRIEDRICH NIETZSCHE. Translated by WILLIAM A. HAUSEMANN. New York and London, The Macmillan Company. 1897. Pp. xix+289. $2.

The Social Mind and Education. GEORGE EDGAR VINCENT. New York and London, The Macmillan Company. 1897. Pp. 146. $1.25.

The Conductors of SCIENCE will be indebted to those who will circulate this advertisement of the Journal. Copies can be obtained from the Publishers.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE.

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*TO OUR READERS.**

THE experience of centuries shows that great success in advancing scientific knowledge cannot be expected even from the most gifted men, so long as they remain isolated. The attrition of like minds is almost as necessary to intellectual production as companionship is to conversation. The commencement of the development of science on a large scale, and with brilliant success, was coeval with the formation of the Royal Society of London and the Academy of Sciences of France. When these bodies came together their members began to talk and to think.

At the present day one of the aspects of American science which most strikes us is the comparative deficiency of the social element. We have indeed numerous local scientific societies, many of which are meeting with marked success. But these bodies cannot supply the want of national coöperation and communication. The field of each is necessarily limited, and its activities confined to its own neighborhood. We need a broader sympathy and easier communication between widely separated men in every part of the country. Our journal aims to supply the want of such a medium, and asks the aid of all concerned in making its efforts successful. It will have little space for technicalities which interest only the specialist of each class, and will occupy itself mostly with those broader aspects of thought and culture which are of interest not only to scientific investigators, but to educated men of every profession. A specialist of one department may know little more of the work of a specialist in another department than does the general reader. Hence, by appealing to the interests of the latter, we do not neglect those of the scientific profession. At the same time, it is intended that the journal shall be much more than a medium for the popularization of science. Underlying the process of specialization, which is so prominent a feature of all the knowledge of our time, there is now to be seen a tendency toward unification, a development of principles which connect a constantly increasing number of special branches. The meeting of all students of nature in a single field thus becomes more and more feasible, and in promoting intercourse among all such students SCIENCE hopes to find a field for its energies, in which it may invite the support of all who sympathize with its aim.

*From the Introduction to the new series of SCIENCE by Professor Newcomb.

An Advertisement of Science.

The first series of Science.

When SCIENCE was established, in 1883, it was at once accepted as the organ of American men of science. Edited by Mr. S. H. Scudder, it early numbered among its contributors nearly all the leading scientific men of the country. The officers and directors of the JOURNAL were: President D. C. Gilman, *President*; Professor Simon Newcomb, *Vice-President*; Hon. Gardiner G. Hubbard, Professor Alexander Graham Bell, Professor O. C. Marsh, Major J. W. Powell, Professor W. P. Trowbridge and Mr. S. H. Scudder.

The sum of eighty thousand dollars was spent in the establishment and support of SCIENCE by Professor A. Graham Bell and the late Mr. Gardiner G. Hubbard. Large as the sum may appear, it is small in comparison with the value of the JOURNAL to science in America.

The new series of Science.

SCIENCE was reorganized three years ago, and has since been under the charge of an editorial committee, consisting of the leading men of science of America. It has, during this period, adequately and fully reflected the progress of science and has been an important factor in its advancement. Its contents have maintained a high and even standard, comparing favorably with any journal in any country. It has stimulated scientific activity and interest in America, and has led to a fuller recognition of American science abroad.

Original Contributions.

SCIENCE aims to give each week just what everyone interested in the advancement of science should read. There are articles and addresses, often by our leading students of science, and always by the most competent writers. These do not conflict with the contents of the special journals, but offer the information and stimulus needed by those who wish to keep abreast of modern science. For example, SCIENCE published an account, by Lord Rayleigh, of the discovery of argon; the first English announcement of *Pithecanthropus erectus*, by Professor Brinton; the first English description of Professor Röntgen's discovery, by Professor Münsterberg, together with the American researches on the subject by Professors Rood, Mayer, Pupin and others; the announcement, by Professors Langley and Bell, of the successful trial of the aërodrome; an article, the best hitherto written, on Acetelene, by President Crafts. The most important recent biological advance, organic selection, was first announced and discussed in SCIENCE by Professors Baldwin, Osborn, Lloyd Morgan and Poulton. Addresses and articles have been contributed by Professor Newcomb, Lord Kelvin, Lord Lister, Professor Foster, President Mendenhall, Mr. Gilbert, Mr. Scudder, Professors Gibbs, Marsh, Remsen, Bowditch, Minot, Brooks, Le Conte, Billings, and the leaders in all departments of science, including Goode, Cope, Allen and others no longer living.

Organization of Science.

All matters relating to the organization of science, associations, academies and societies, journals, universities, museums and other institutions, both here and abroad, the scientific departments under the government, legislation and related subjects have been fully reported and discussed in SCIENCE. Thus, for example: The American Association for the Advancement of Science, the National Academy of Sciences, the various national societies devoted to a special science, the State and local academies and societies, have had their proceedings reported, and not by writers for the press, but by officers of the societies. SCIENCE has published the report of the Forestry Commission of the National Academy of Sciences, the legislation on standards and on the metric system, the official report in defense of vivisection, plans for the reorganization of the scientific departments under the government, and many similar documents. On scientific education contributions have been made by President Jordan, Professors Bessey, Shaler, Coulter, Carhart, Freer, Gage and others equally competent. Editorial articles and

notes have been prepared, whenever it was thought that the weight of the JOURNAL should be used for the defense and advancement of scientific interests.

Progress of Science.

SCIENCE publishes in every issue articles on the progress of science. Sometimes these are announcements of new advances, but nearly always of a character to make them intelligible and interesting to those having no special knowledge of the subject. More frequently, they are reports of work, the details of which are published elsewhere, or reviews of the general advance in some department of science. It would be impossible to mention, within the limits of this advertisement, all those who have made such contributions. They include men of science from practically every university and institution in America showing scientific activity. There is further given, weekly, a series of notes by the most competent authorities, reviewing important scientific advances. The notes contributed by Professors Brinton, Davis, Bessey, Osborn, Howe, Frost and others are of unusual value to those who wish to keep informed on the progress of science. Each week pages of items of scientific news are published, which alone would make it essential for everyone to read the JOURNAL who wishes to keep informed on current scientific interests and activity.

Scientific Literature.

Scientific books are reviewed weekly in SCIENCE, the most recent information and authoritative estimate of new publications being given. It is probable that no journal in America is able to publish reviews of such weight as those contributed to SCIENCE. While the special journals may give information regarding new publications in a single science, it is necessary for everyone to know something of the more important books in other sciences, and for this purpose SCIENCE is essential. Some notice is also given of the contents of special journals and other smaller contributions which might otherwise escape attention.

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The weekly appearance of SCIENCE, the wide fields it covers, and the fact that it is read by practically everyone interested in scientific matters, makes it the best medium for discussion and correspondence. This has been generally recognized and the department usually contains contributions of great interest tending to promote acquaintance and intercourse between men of science. This department alone is of sufficient importance to warrant the continuation and success of the JOURNAL.

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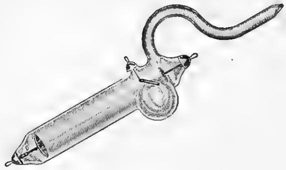

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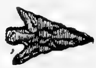

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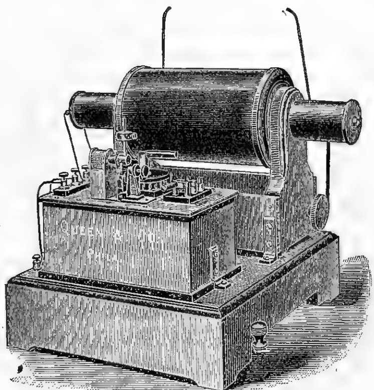

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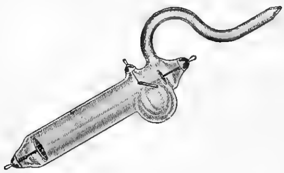

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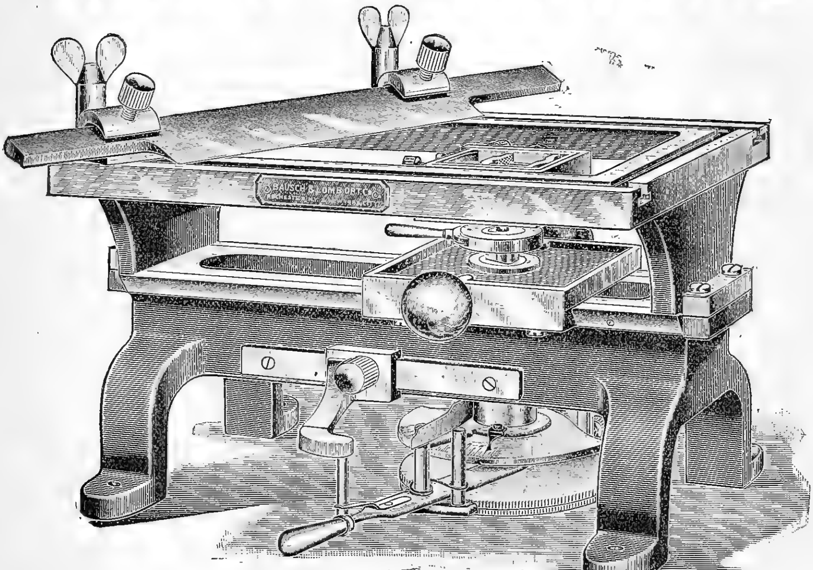

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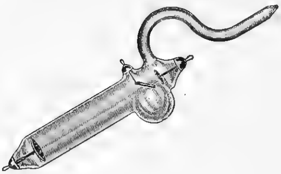

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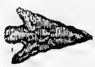

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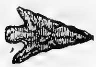

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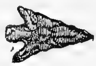

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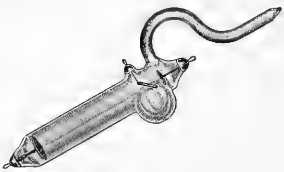

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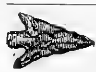

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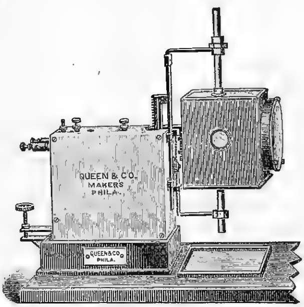

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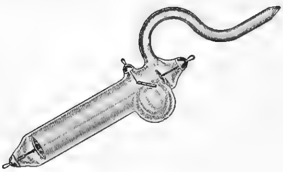

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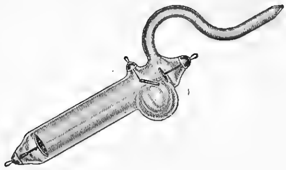

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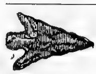

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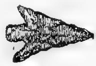

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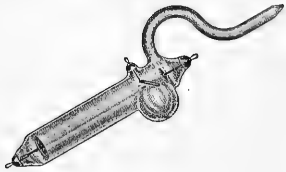

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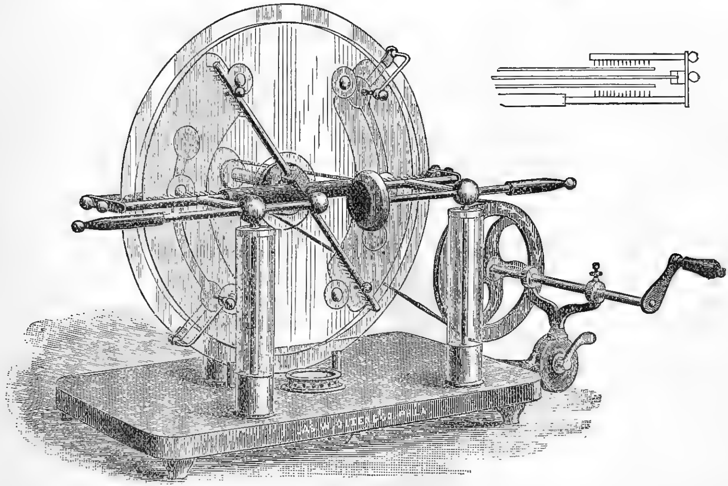

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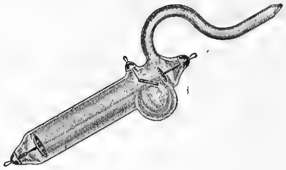

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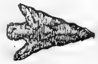

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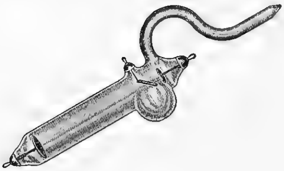

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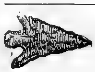

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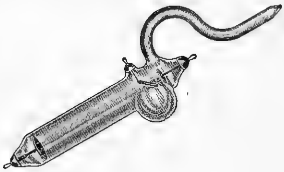

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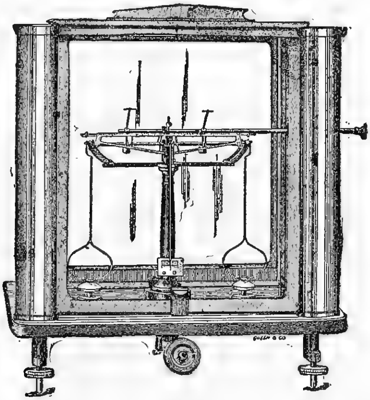

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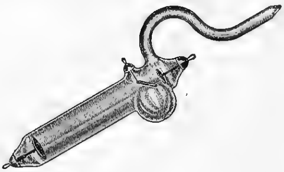

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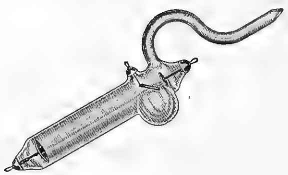

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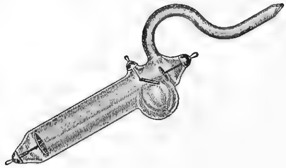

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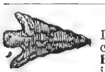

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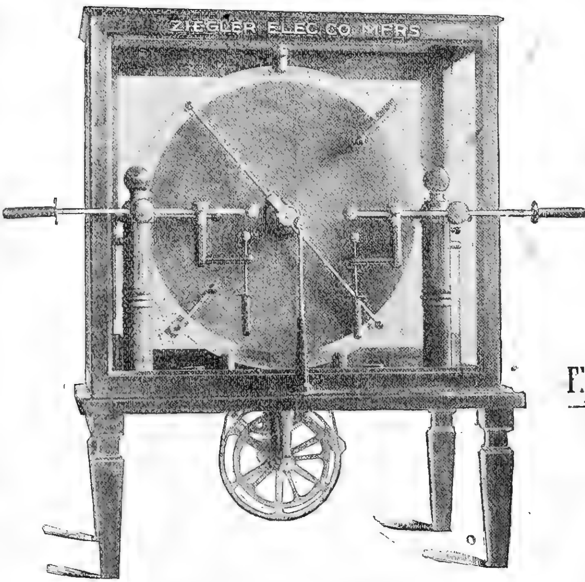

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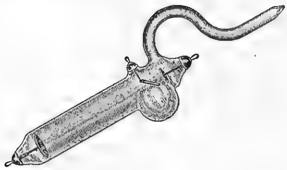

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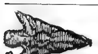

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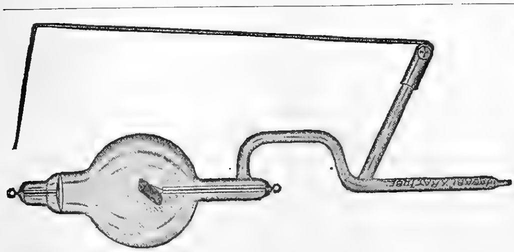

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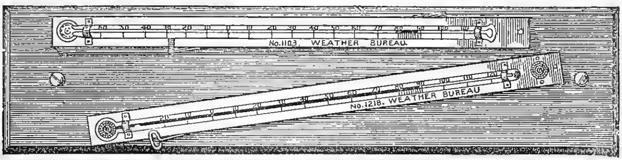

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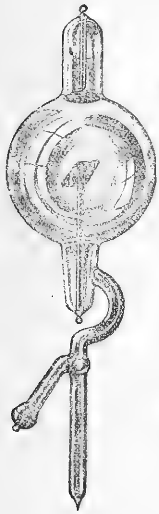

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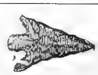

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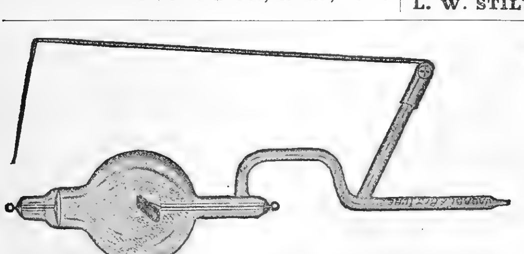

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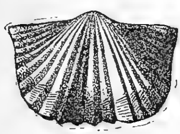

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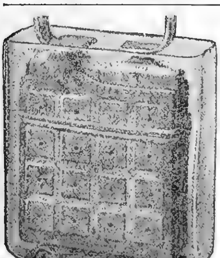

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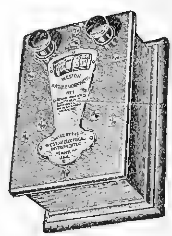

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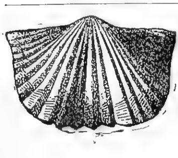

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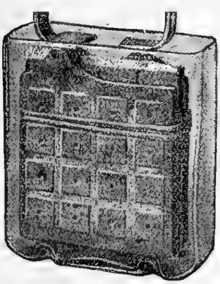

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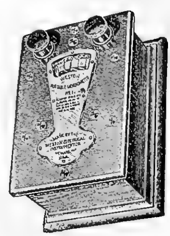

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